ABSTRACTS OF NORTH AMERICAN GEOLOGY

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WALTER J. HICKEL, *Secretary*

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William T. Pecora, *Director*

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ABSTRACTS OF NORTH AMERICAN GEOLOGY

INTRODUCTION

Abstracts of North American Geology contains abstracts of technical papers and books and also citations of maps on the geology of North America including Greenland, the West Indies, as well as the State of Hawaii, Guam, and other island possessions of the United States. Articles of a general nature by North American authors are cited even though published in foreign journals but those by foreign authors are included only if they appear in North American journals. Abstracts are prepared only of material that is believed to be generally available. Ordinarily abstracts are not published of material with small circulation (such as dissertations, open-file reports of memorandums) or of other papers presented orally at meetings.

The Abstracts is an additional reference tool but does not replace the Bibliography of North American Geology, which has been published by the Geological Survey since 1887. Twelve monthly issues of Abstracts of North American Geology are published each year. The Bibliography includes citations and subject index for a calendar year.

The numbers assigned to the abstracts in this publication are for reference in using the index; they are not order numbers. Publications cited here in abstract form are available in most geological libraries or through interlibrary loan.

Abstracts of North American Geology and the Bibliography are prepared by use of computer techniques. Each abstract, along with its indexing, is placed on magnetic tape and entered into a permanent data bank. The material prepared each month is published in the form of the present issue. The abstracts are arranged alphabetically according to senior author. A subject index follows the abstracts and is designed for rapid reference to any subject desired. Bibliographies can subsequently be retrieved according to the terms used in the index.

A list of journals commonly cited in Abstracts of North American Geology may be obtained by writing to the U.S. Geological Survey, Washington, D. C. 20242. Serial publications cited for the first time are as follows:

Cave Sci.—Cave Science. Journal of the British Speleological Association. Settle, Yorkshire, England.

Modern Geology—Modern Geology. Gordon and Breach Science Publishers. New York and London.

North Carolina Div. Mineral Resources Geol. Map Ser.—North Carolina Department of Conservation and Development, Division of Mineral Resources, Geologic Map Series. Raleigh, N. C.

Phytochemistry—Phytochemistry. An international journal of plant biochemistry. Pergamon Press. Oxford, England.

Soviet Soil Sci.—Soviet Soil Science. (Translation of Pochvovedeniya). Scripta Publishing Corporation. Washington, D. C.

The abstracts in this issue were prepared by Wilbur S. Burbank, Georgianna D. Conant, Howard R. Cramer, Michael Fleischer, Elizabeth Hambleton, Anna Hietanen-Makela, Ralph W. Imlay, Virginia M. Jussen, R. A. Loney, Elisabeth S. Loud, Mildred C. Mead, E. A. Merewether, Willis H. Nelson, Virginia S. Neuschel, Robert B. O'Sullivan, Earl H. Pampeyan, Donald H. Richter, E. G. Sable, Marie Siegrist, Roger W. Swanson, Gregg Vane, Dorothy B. Vitaliano, R. G. Yates, and Ellis L. Yochelson.

ABSTRACTS

Abey, A. E. *See* Giardini, A. A. 01763

01602 **Addicott, W. O.** Tertiary climatic change in San Joaquin basin, California — Evidence from shallow-water mollusks [abs.]: Am. Assoc. Petroleum Geologists Bull., v. 54, no. 3, p. 561, 1970.

08939 **Afshar, Freydoun.** Taxonomic revision of the superspecific groups of the Cretaceous and Cenozoic Tellinidae: Geol. Soc. America Mem. 119, 215 p., illus., 1969.

Earlier classifications of the heterodont bivalve family Tellinidae are reviewed, and a classification based on shell characters is proposed: the nature and relative position of the hinge teeth, and the nature and size of the pallial sinus are stable characters used in generic classification; less stable characters, for infrageneric distinctions, are shape and size of shell, sculpture, relative position of umbones. The family is divided into 15 genera; 10 are divided into 86 subgenera (besides nominotypes), of which 10 are new. Keys to genera and almost all subgenera are provided. A diagnosis of each genus and subgenus is given, with bibliographic references, citation of type species, geologic range of taxon; each type species is described and figured. In an appendix by H. A. Rehder, cited separately, similar data are given for 12 additional taxa proposed after Afshar's work was completed in 1952. — VMJ

09030 **Ahrens, T. J.; Petersen, C. F.** Shock wave data and the study of the Earth, *in* The application of modern physics to the earth and planetary interiors (S. K. Runcorn, editor): London and New York, Wiley-Interscience, p. 449-461, illus., tables, 1969.

Basic concepts underlying equation of state measurements on earth materials using shock wave techniques are discussed, and results of experiments on Twin Sisters olivine and experiments of others are examined. Results provide direct evidence for "breakdown of olivine to a yet unknown structure having the density of the oxides; this presumably occurs in the Earth at depths of about 650 km. It appears that this type of reaction can occur in the submicrosecond time scale of a shock experiment." — VSN

Alexander, E. C., Jr. *See* Srinivasan, R. 01836

08941 **Alexander, Gail.** (chairman, Education Comm., Midwest Federation Mineralog. and Geol. Socs.). Bibliography of earth science materials: [Downers Grove, Ill., Earth Sci. Publishing Co.,?] 54 p., 1969.

Prepared principally for rockhounds, the bibliography is divided into two sections: (1) subjects — gemstones, jewelry making and lapidary; geology; mineralogy; paleontology — and (2) general earth science materials available from the states of Arkansas, Illinois, Indiana, Iowa, Kansas, Kentucky, Michigan, Minnesota, Missouri, Nebraska, North Dakota, Ohio, South Dakota, Tennessee, and Wisconsin. — MCM

Allègre, Claude J. *See* Montigny, Raymond, 01636

01539 **Allen, J. R. L.** Studies in fluviatile sedimentation — A comparison of fining-upwards cyclothems, with special reference to coarse-member composition and interpretation: Jour. Sed. Petrology, v. 40, no. 1, p. 298-323, illus., tables, 1970.

Six cyclothems in the Devonian of the Appalachian region are described. The cyclothems when complete consist each of a lower coarser member and an upper fine member, between which the facies are distributed. An analysis of facies transitions is made to arrive at an understanding of the composition and variability of these cyclical deposits. The coarse members are more variable than the fine members, and are formed through processes of lateral deposition in streams with sinuous thalwegs. A quantitative physical model is advanced to show how the different facies sequences observed in the coarse members can be understood in terms of the chief variables involved in river flow. Specifically, the model reproduces the vertical pattern of grain size and sedimentary structure observed in the coarse members, and shows how coarse members can be interpreted in terms of stream power and channel sinuosity. — *from* Author's abstract

01426 **Allen, John Eliot.** Art and geology: Geotimes, v. 15, no. 4, p. 16-17, illus., 1970.

In the lobby of the Department of Earth Sciences at Portland (Oregon) State University are 9 large oil and acrylic paintings, and 5 bronze and ceramic sculptures, along with smaller water colors, pen-and-ink sketches and stitcheries to illustrate the application of artistic talent and media to explication of geologic principles and objects. Each large painting is accompanied by a small index sketch locating and identifying landforms, minerals, fossil reconstructions or rock types. Two short courses in geologic illustration are offered to art majors who have taken a course in geology. — GDC

08908 **Alley, C. O.; Bender, P. L.; Currie, D. G.; Dicke, R. H.; Faller, J. E.** Some implications for physics and geophysics of laser range measurements from Earth to a lunar retro-reflector, *in* The application of modern physics to the earth and planetary interiors (S. K. Runcorn, editor): London and New York, Wiley-Interscience, p. 523-530, 1969.

The possibility is discussed of increased understanding of the Chandler wobble through better measurement of tipping of the Earth with respect to axis of rotation, and of a definitive test of the conjectured secular decrease of the gravitational constant by means of precise laser range measurement of distances from the Earth to a retro-reflector on the Moon. — VSN

01525 **Am. Soc. Civil Engineers.** (Task Comm. on Preparation of Sedimentation Manual). Sediment measurement techniques — [Pt.] C, Accelerated valley deposits: Am. Soc. Civil Engineers Proc., v. 96, paper 7269, Jour. Hydraulics Div., no. HY 5, p. 1157-1166, illus., tables, 1970.

Culturally accelerated deposition of sediment in alluvial valleys has been recognized in the U.S. since 1801 or earlier. Such deposition is most common in valleys with drainage areas smaller than a few hundred square miles, where there has been upland gullying, and where substantial proportions of sand were available. The modern sediment deposit may be recognized by texture, color, compaction, distinctive minerals, buried artifacts, or stratification. These deposits are measured using base maps, surveying, boring, mapping, and sampling. Guidance is given in calculating volumes, tabulating, interpreting, and reporting the data obtained. — ASCE abstract

09008 **Amsbury, David L.** Geological comparison of spacecraft and aircraft photographs of the Potrillo Mountains, New Mexico, and Franklin Mountains, Texas, *in* Symposium on remote sensing of environment, 6th Internat., Ann Arbor, Mich., 1969, Proc., V. 1: Ann Arbor, Mich., Univ. Michigan, Willow Run Labs., p. 493-515, illus., table, 1969.

Color photographs of southern New Mexico were obtained during Apollo 6 and Apollo 7 flights in 1968 and Apollo 9 in 1969; Apollo 9 also took color infrared and black-and-white photographs of the region. Similar photographs were taken of the Potrillo and Franklin Mountains from high- and low-altitude aircraft during the Apollo 7 and 9 missions. Photographic scales of the films were 1:3,000,000, 1:250,000, 1:62,500, 1:40,000 and 1:20,000. Effective ground resolutions ranged from several hundred to approximately 5 feet. Comparing photographs by photointerpretation

methods, geological information content of any type of color film was found to be approximately the same at a given resolution. Interpretation is quicker and more accurate with color photography than with black-and-white. Scales of 1:2,500,000 and 1:60,000 are good for regional mapping and 1:250,000 and 1:24,000 for detailed study. — *from* Author's abstract

Anders, Edward. *See* Larimer, J. W. 01862

09104 **Andersen, Neil R.** Chemistry of the sea, *in* Exploring the ocean world (C. P. Idyll, editor): New York, Thomas Y. Crowell Co., p. 98-129, illus., tables, 1969.

Development of the study of the chemistry of seawater and techniques of collecting and analyzing water samples are discussed. Salinity of seawater, expressed in parts per thousand, averages 35/100, but this average can be changed by physical processes of precipitation, evaporation, or mixing of water masses. Chemical content of seawater includes major and minor elements, dissolved gases, and radioactive isotopes. Dissolved nitrogen and oxygen are especially important for sustaining marine life, as well as other nutrient chemicals such as phosphorus and silicon. Oxygen content of seawater can be altered by photosynthesis, utilization by animals, decomposition of organic matter, depth and other factors. Some forms of marine life, which collect certain chemical elements from seawater in their bodies, can affect the composition of the water. Tables of chemical content of seawater and of processes affecting the content are included. — EH

01733 **Anderson, Alfred T., Jr.** Nickel in basaltic olivine and glass [abs.]: EOS, v. 51, no. 4, p. 443-444, 1970.

Anderson, C. W., 3d. *See* Reitzel, J. S. 01856

08970 **Anderson, D. L.; Sammis, C. G.; Phinney, R. A.** Brillouin scattering — A new geophysical tool, *in* The application of modern physics to the earth and planetary interiors (S. K. Runcorn, editor): London and New York, Wiley-Interscience, p. 465-477, illus., table, 1969.

Conventional ultrasonic methods of determining elastic constants of earth materials for interpretation of the physics and chemistry of the interior use transducers that are bonded to the specimen and require shaping of the sample. The method of 'Brillouin scattering' uses thermally generated sound waves to scatter light waves, and the spectrum of scattered light provides the velocity of thermally excited sound waves. The method is nondestructive, no physical contact with the sample is required, and it can be used on small crystals; it requires only a sample cell with 3 small optical windows. A summary tabulation is given of Brillouin scattering measurements in solids for longitudinal and transverse modes. — VSN

08991 **Anderson, Don L.; Sammis, Charles.** La zona de baja velocidad — The low velocity zone [Spanish and English texts], *in* Pan American symposium on the upper mantle, México, D.F., 1969—Group 5, Seismology: Geofísica Internac., v. 9, nos. 1-3, p. 3-19, illus., tables, 1969.

Partial melting is consistent with low velocity, low Q and abrupt boundaries of the low-velocity zone of the upper mantle and also with measured heat-flow values. Inferred low melting temperatures indicate that water pressure is high enough to lower the solidus about 200° to 400°C below laboratory determinations of the melting point of anhydrous silicates. The top of this zone can be considered a self-lubricated surface upon which the top of the mantle and the crust can slide with little friction. Motion of crust and upper mantle away from oceanic rises is counterbalanced by flow of molten material in this layer toward the rise where it emerges as new crust. If the lateral flow of molten material is not as efficient as upward removal of magma, the regions of extrusion, such as oceanic rises, will migrate. — *from* Author's abstract

Anderson, Franz E. *See* Gaudette, Henri E. 01548

01529 **Anderson, G. S.** Hydrologic reconnaissance of the Tanana basin, central Alaska: U.S. Geol. Survey Hydrol. Inv. Atlas HA-319, 4 sheets, scale 1:1,000,000, text, 1970.

Sheet 1, physical setting, includes maps, a block diagram, and graphs on climate, physiography, and vegatation of the Tanana basin. Sheet 2, geohydrology, includes a hydrogeologic map with an explanation and summary of water-bearing units, inset maps, and graphs. Information on water-bearing properties of the igneous and sedimentary rocks is very limited. The basin is mantled by unconsolidated Quaternary deposits in the form of glacial, alluvial, eolian, or colluvial sediments; the first three are generally productive aquifers, with yields up to 3,000 gpm. The area is entirely within the discontinuous permafrost zone and frozen areas outnumber unfrozen areas. Permafrost restricts recharge, discharge, and movement of ground water, creates artesian conditions, and limits storage capacity. Little is known concerning the volume in storage and changes of storage as permafrost in the basin. Sheet 3 contains information on surface water and sheet 4 on quality of water; alluvial fans provide the largest source of good-quality water. — MCM

08969 **Anderson, O. L.; Liebermann, R. C.** Elastic constants of oxide compounds used to estimate the properties of the Earth's interior, *in* The application of modern physics to the earth and planetary interiors (S. K. Runcorn, editor): London and New York, Wiley-Interscience, p. 425-448, illus., tables, 1969.

Using measured temperature and pressure derivatives of elastic-wave velocities to establish the thermal gradient necessary to produce a low-velocity layer, it is found that this critical gradient is lower for shear waves than for compressional waves in the corundum, periclase, α-quartz, forsterite, spinel, and garnet studied. Parameters are the ambient density and mean atomic weight. The law of corresponding states, and observed patterns relate the parameters in Murnaghan's equation of state in such a way that chemical composition has little effect on either density-pressure trajectories for the lower mantle or limiting density of the mantle near the core-mantle boundary. The effect of pressure dominates over temperature in the lower mantle. The value of computed density can be altered by variation in iron content. — MF

Andrieux, Pierre. *See* Weber, J. R. 01451

Antoine, John W. *See* Pyle, Thomas E. 09131

Archambeau, Charles B. *See* Smith, Stewart W. 01625

01687 **Armstrong, Augustus K.** Foraminifera and rugose coral zones of Mississippian-Pennsylvanian Lisburne Group, Brooks Range, Arctic Alaska [abs.]: Am. Assoc. Petroleum Geologists Bull., v. 54, no. 3, p. 559, 1970.

08898 **Atkinson, T. C.** The geology of the country around Maldon and Maroon Town, St. James, Jamaica, *in* Limestone geomorphology, a study in Jamaica: Cave Sci., v. 6, nos. 43-44, p. 90-95, illus., 1969.

Shown on outcrop map, much of this Tangle River catchment basin, and some ground to the south and east, is Tertiary, divided into the lower Yellow Limestone and upper White Limestone, unconformable upon southward-dipping Cretaceous rocks, 1,650 ft thick. Outcropping in three principal inliers, largest of which is the Maldon Inlier, the Cretaceous succession has three rock types described separately: reef limestones, mudstones, and sandstones and conglomerates. Lithofacies relations are shown and faunal assemblages are listed. Dips of the Cretaceous are usually steeper than dips of the Tertiary rocks; change in strike is thought due to changes in original depositional strike. The Maldon Inlier is bounded on north by faults, in three stages, one predating the Yellow Limestone. The impervious inliers form closed basins, enlarged by scarp recession of surrounding karsted limestone in which subsurface streams supply and drain the inliers, sinking at the northern boundary faults. — GDC

08903 **Atkinson, T. C.** Report on cave exploration in Jamaica, 1967, *in* Limestone geomorphology, a study in Jamaica: Cave Sci., v. 6, nos. 43-44, p. 151-161, illus., 1969.

Twenty-four new caves were explored around Maroon Town within the study area of the University of Bristol Karst Hydrology Expedition, with a total passage length of

less than 3 miles, and four caves were explored outside the area. This area is a closed inland basin, floored by an inlier of southward dipping Cretaceous limestones and mudstones, and surrounded by the Tertiary Yellow Limestone, 300-500 feet thick, sandy at base but increasingly pure upwards into the White Limestone, also Tertiary. The caves form the underground course of the Tangle River and Maldon River. Each cave is described briefly. — GDC

01702 **Atwater, Tanya; Menard, H. W.** Magnetic lineations in the northeast Pacific: Earth and Planetary Sci. Letters, v. 7, no. 5, p. 445-450, illus., 1970.

Magnetic data for the northeast Pacific are summarized and interpreted in terms of sea floor spreading. Unclear areas exist in the "disturbed zone" and west of the Juan de Fuca Ridge. The direction of spreading changed about 55 m.y. ago. An intermediate plate was gradually destroyed as segments of this ridge neared the continent and the timing of this destruction appears related to the timing of the origin of the San Andreas fault system. — Authors' abstract

01536 **Austin, George S.** Weathering of the Sioux Quartzite near New Ulm, Minnesota, as related to Cretaceous climates: Jour. Sed. Petrology, v. 40, no. 1, p. 184-193, illus., 1970.

The silica cement matrix of the Precambrian Sioux Quartzite has been removed and the argillaceous part (probably sericite) of the cement matrix has been altered to kaolinite. Upper Cretaceous rocks, primarily red and green shale, siltstone, and sandstone, overlie the weathered quartzite. Illite and montmorillonite are the principal clay minerals in these rocks, with kaolinite present in minor amounts. The significant change in clay mineralogy, coupled with paleontological evidence, indicates a pronounced change in climatic conditions during Cenomanian time. The humid tropical climate with good drainage, conducive to kaolin formation, was replaced by a temperate climate with poor drainage. The Sioux Quartzite stood as a highland during the formation of the kaolinitic regolith and shed its weathering products into topographically lower areas; the quartz sand now forms a large part of the Dakota Formation of Minnesota. — *from* Author's abstract

08880 **Auston, J. S.** Uchi Lake — A geophysical discovery [abs.]: Geophysics, v. 34, no. 6, p. 1014, 1969.

01612 **Bachman, George O.; Harbour, Robert L.** Geologic map of the northern part of the San Andres Mountains, central New Mexico: U.S. Geol. Survey Misc. Inv. Map I-600, scale 1:62,500, section, 1970.

01714 **Bachmat, Y.; Elrick, D. E.** Hydrodynamic instability of miscible fluids in a vertical porous column: Water Resources Research, v. 6, no. 1, p. 156-171, illus., tables, 1970.

A series of experiments have been conducted at a constant temperature on intrusion of salt from a reservoir containing a fixed volume of solution into an underlying vertical column of porous material, initially saturated with pure water and sealed at the bottom. The variation with time of the salt concentration in the reservoir was measured for different types of porous materials, different initial concentrations, and different mechanical treatments of the solution. Results, substantiated by theoretical analyses, indicate that the main contributor to influx of salt into the porous material is convective dispersion arising from the onset of horizontal variations of the salt concentration and of the vertical velocity component. Approximate expressions have been derived for rate of decrease in salt concentration in the reservoir, for influx of salt into porous material, and for advances of the salt front within it. — *from* Authors' abstract

01584 **Back, William.** Chemical hydrogeology of the carbonate peninsulas of Florida and Yucatan [abs.]: Dissert. Abs. Internat., Sec. B, Sci. and Eng., v. 30, no. 9, p. 4241B, 1970.

01730 **Backus, G.; Gilbert, F.** Uniqueness in the inversion of inaccurate gross Earth data: Royal Soc. London Philos. Trans., sec. A, v. 226, no. 1173, 192 p., illus., tables, 1970.

A gross Earth datum is a single measurable number describing some property of the whole Earth. It is shown that some such sets of measurements determine the structure of the Earth within certain limits of error except for fine-scale detail, and also how to determine whether a given set permits such a construction of localized averages and if so, how to find the shortest length scale over which the set gives a local average structure at a particular depth. The general theory is applied to the linear problem of finding depth variation of a frequency-independent local elastic dissipation (Q) from observed damping rates of a finite number of normal modes, and to the nonlinear problem of finding density against depth from total mass, moment, and normal-mode frequencies when P and S velocities are known. — DBV

09123 **Bailey, E. H.; Blake, M. C., Jr.** Tektonicheskoye razvitiye zapadnoy Kalifornii v pozdnem mezozoye — Stat'ya 2, Metamorfizm i yego svyaz' s regional'noy tektonikoy [Tectonic development of western California in the Late Mesozoic — Pt. 2, Metamorphism and its relationship with regional tectonics]: Geotektonika 1969, no. 4, p. 24-34, illus., 1969; English translation, Geotectonics 1969, no. 4, p. 225-230, 1969.

The metamorphic rocks of the Franciscan complex are chiefly glauconite schists containing aragonite, lawsonite and jadeite. The presence of these minerals indicates their probable formation at considerable depth, at low temperatures, and during high pressure from tectonic stresses. Sedimentation proceeded in the Great Valley and Franciscan troughs from Early to Late Cretaceous. In the Lower Cretaceous, subcrustal currents displaced the area of the Franciscan Formation eastward, and continuing movement during Middle and Late Cretaceous led to a westward overthrust of the Franciscan rocks by those of the Great Valley section for a distance of 75 km. During the same period of time, rocks along this thrust surface were metamorphosed to glauconite schists. — EH

09024 **Baird, D. M.** Canada's spectacular piercement domes: Canadian Geog. Jour., v. 79, no. 3, p. 76-83, illus., 1969.

Airphotos of the Arctic islands show a number of unusual patterns, which ground parties have discovered to be piercement domes. Domes on the islands and some in Nova Scotia, Newfoundland, and British Columbia are described. A study of gypsum outcrops shows that it is always a surface alteration of anhydrite, and forms a skim on the top of large masses, and where salt is absent some of the flowage may be due to anhydrite alone. Inclusions of diorite and sedimentary rocks are found in the gypsum-anhydrite in Arctic domes. The piercement structures occur in a northeast-trending belt from the Sabine Peninsula to Axel Heiberg Island, and some may still be growing. — ESL

Baker, D. W. *See* Wenk, H. R. 01870

01416 **Baker, R. A.** Oscillation ripplemarks and orbital diameter: Geol. Soc. America Bull., v. 81, no. 5, p. 1589-1590, 1970.

Ripplemark wavelength, L, is related to median sediment diameter, M, and orbital diameter, D, of waves at the sea floor by the empirical equation $L = .00136\ M^{1.6575}\ D^{-.3837}$. This indicates at reverse relation between ripplemark wavelength and orbital diameter, a result contrary to expectation. — Author's abstract

01734 **Baksi, A. K.** K-Ar dating of a "Recent" lava flow [abs.]: EOS, v. 51, no. 4, p. 432, 1970.

Baldwin, Ewart M. *See* Boggs, Sam, Jr. 01721

Ball, George E. *See* Karlstrom, Thor N. V. 08904

Ball, Mahlon. *See* Bonatti, Enrico. 01694

Banner, James. *See* Freeze, R. Allan. 01715

Barnes, H. L. *See* Helz, G. R. 01780

01673 **Barnes, Ivan.** Metamorphic waters from the Pacific tectonic belt of the west coast of the United States: Science, v. 168, no. 3934, p. 973-975, table, 1970.

Waters unusually rich in ammonia, boron, carbon dioxide, hydrogen sulfide, and hydrocarbons are found in more than 100 localities along the Pacific coast of the United States. The waters are believed to be products of low-grade metamorphism of marine sediments. The marine sedimentary rocks would have to be tectonically emplaced below crystalline rocks in many places. Mercury ore deposits are probably also products of the low-grade metamorphism. — Author's abstract

01661 **Barr, Jim L.; Dinkelman, M. G.; Sandusky, C. L.** Large epoxy peels: Jour. Sed. Petrology, v. 40, no. 1, p. 445-449, illus., 1970.

A method is outlined for making large epoxy relief-peels in unsaturated or water-saturated sediments. The making of the peel, which is made from vertical cuts in trenches, involves a minimal amount of equipment and only two to three hours in curing time. The resulting relief-peel is large in size, shows excellent clarity of both large and small stratification features, and is quite adequate for grain and shell orientation studies. — Authors' abstract

Barrett, P. J. *See* Lindsay, John F. 01550

09097 **Barringer, A. R.; McNeill, J. D.** Recent developments in remote sensing for geophysical applications, *in* Symposium on remote sensing of environment, 6th Internat., Ann Arbor, Mich., 1969, Proc., V. 1: Ann Arbor, Mich., Univ. Michigan, Willow Run Labs., p. 617-636, illus., tables, 1969.

Many electromagnetic sensors, available for use in mineral exploration, respond to very high conductivity. INPUT and Radiophase systems have a high potential for geological mapping. Radiophase uses transmissions from VLF radio stations located about the world. The vertical electric field is used as a phase reference against which to measure both phase and amplitude variations of the 3 components of the VLF magnetic field. Techniques used for data acquisition and reduction are described and results of a recent survey over the Precambrian shield in northern Quebec and Ontario are given. The INPUT system, which can distinguish effects of conductive overburden, has been used for many years as a major mineral exploration tool. Since it is a pulsed system and high frequencies are present, subtle variations in the near-surface conductivity can be effectively mapped and presence of layering detected. Preliminary results in the search for gravels with a 12-channel INPUT are given. — *from* Author's abstract

01735 **Barron, L. M.** Thermodynamic multicomponent silicate phase equilibrium calculations [abs.]: EOS, v. 51, no. 4, p. 437-438, 1970.

Barsky, Constance K. *See* Condie, Kent C. 01751

01471 **Bayley, Richard W.** Iron deposits of the Estes Creek area, Lawrence County, South Dakota, *in* Geological Survey research 1970, Chap. B: U.S. Geol. Survey Prof. Paper 700-B, p. B93-B101, illus., table, 1970.

The Estes Creek iron deposits underlie a hilltop area in excess of 2 million square feet. Tightly folded Precambrian sedimentary iron-formation (taconite), about 29 percent iron, makes up the deposit. Laboratory tests by the U.S. Bureau of Mines show that the iron-formation is amenable to concentration. It is estimated that this deposit plus smaller deposits nearby could sustain a nominal mining venture. — Author's abstract

Bayrock, L. A. *See* Pawluk, S. 08935

Bé, A. W. H. *See* Ruddiman, W. F. 01643

01423 **Bear, Melvern F.** Everett L. Bradley (1897-1969): Am. Assoc. Petroleum Geologists Bull., v. 54, no. 4, p. 665-666, portrait, 1970.

08955 **Beck, A. E.** Energy changes in an expanding Earth, *in* The application of modern physics to the earth and planetary interiors (S. K. Runcorn, editor): London and New York, Wiley-Interscience, p. 77-83, illus., table, 1969.

Beck's primitive Earth model is discussed along with those of Birch and of others; it is shown that models with plausible density distributions can be found which allow an expansion of the radius of about 400 km. If all radioactive energy is put into expansion, this would permit a further 200 to 300 km; but since the moment of inertia of the primitive Earth was much higher (9.0, for example, as suggested by Birch and Runcorn) than at present, the possible radial expansion is restricted to less than 100 km. Thus a radial increase of the order of 1,000 km seems improbable but one of the order of 100 km cannot be ruled out. — VSN

01571 **Beeson, Marvin Howard.** A trace element study of silicic volcanic rocks [abs.]: Dissert. Abs. Internat., Sec. B, Sci. and Eng., v. 30, no. 9, p. 4204B-4205B, 1970.

Behunin, Homer. *See* Tidwell, William D. 01677

01736 **Bell, Peter M.; Chao, E. T. C.** Annealment of synthetic and natural feldspar glass [abs.]: EOS, v. 51, no. 4, p. 439, 1970.

01864 **Belsky, T.; Kaplan, I. R.** Light hydrocarbon gases, C^{12}, and origin of organic matter in carbonaceous chondrites: Geochim. et Cosmochim. Acta, v. 34, no. 3, p. 257-278, illus., tables, 1970.

Analyses for light hydrocarbon gases were carried out on 11 meteorites and on terrestrial sediments, using gas chromatography. Compounds ranging from C_1 to C_6 were identified. The distribution of compounds was different in the different meteorites studied; both saturated and unsaturated hydrocarbons were detected, and benzene was generally a relatively minor component. The trace constituents identified are present as gases trapped between crystal boundaries. δC-13 measurements on total meteorite carbon indicate three possible groupings of the data: values falling below -20 permil characteristic of the ordinary chondrites; values between -7 and -20 permil representing carbonaceous chondrites; and values at about -6 permil representing graphic carbon. The results imply that equilibrium among the carbon constituents has not been attained. — *from* Authors' abstract

01738 **Bence, A. E.; Cameron, K. L.; Papike, J. J.** Sector zoning in calcic clinopyroxenes [abs.]: EOS, v. 51, no. 4, p. 435, 1970.

Bender, P. L. *See* Alley, C. O. 08908

Bennett, E. O. *See* Schneider, H. 01635

08965 **Berg, C. A.** The diffusion of boundary disturbances through a non-Newtonian mantle, *in* The application of modern physics to the earth and planetary interiors (S. K. Runcorn, editor): London and New York, Wiley-Interscience, p. 253-272, illus., table, 1969.

The possibilities are considered that the main mechanism of permanent deformation in the mantle is either Andradean viscous flow or ideal plastic deformation. The consequences of assuming either of these two types of behavior in mantle convection are compared with observations along midoceanic ridges. It is concluded that the mechanism of permanent deformation in the mantle is most probably not Andradean viscous creep, and continued investigations based upon assumptions that either Newtonian viscous flow or Andradean viscous creep is the principal mechanism will not provide results useful in determining quantitative aspects of mantle motion. Investigations based upon plastic deformation may provide significant results concerning thermal convection, or possibly thermal convection should be discarded and alternative mechanisms considered. — VSN

08966 **Berg, C. A.** The formation of oceanic trenches and the mechanism of permanent deformation in the mantle, *in* The application of modern physics to the earth and planetary interiors (S. K. Runcorn, editor): London and New York, Wiley-Interscience, p. 273-283, illus., 1969.

The chief mechanism for producing an oceanic trench is amplification of surface irregularities by a compressive stress field acting in the upper layer of the mantle near the continental edge. This is examined quantitatively on the basis of the exact solution for finite motion of the surface of a cylindrical hole of arbitrary cross section in an infinite body of incompressible Newtonian viscous fluid subject to arbitrary loading at infinity. However, the presence of a single oceanic trench near continental boundaries suggests that surface irregularities on the upper mantle are amplified only when horizontal compressive loading attains some critically large value, which in turn suggests that mantle deformation is by plastic not viscous flow. If the mantle were viscous, a whole sheet of large-scale trenches should be found, not just a single trench. — VSN

01737 **Berger, Glen W.; York, Derek.** Precision of the Ar-40/Ar-39 dating technique [abs.]: EOS, v. 51, no. 4, p. 432, 1970.

01410 **Berger, Wolfgang H.** Biogenous deep-sea sediments — Fractionation by deep-sea circulation: Geol. Soc. America Bull., v. 81, no. 5, p. 1385-1401, illus., tables, 1970.

Lagoonal basins, with deep water outflow, are characterized by waters that have low nutrient concentrations and high salinity and are well aerated; their sediments are rich in calcium carbonate. Estuarine basins, with deep water inflow, contain waters with high nutrient concentrations, low salinity, and little oxygen; their sediments are rich in silica and organic matter, and tend toward being anaerobic. The Atlantic Ocean is "lagoonal" and the Pacific Ocean is "estuarine." The fractionation of silica from lime through basin-basin exchange of water at different levels is due to both supply and preservation patterns. Supply of biogenous precipitates to the ocean floor exceeds influx of solutes, requiring dissolution to maintain steady state. Supply is greatest in estuarine basins. Dissolution of lime proceeds fastest in estuarine basins whereas dissolution of silica is greatest in lagoonal basins. —*from* Author's abstract

09091 **Bergström, Stig M.; Sweet, Walter C.** Ordovician conodont localities, southwestern Ohio, Field Trip 3 *in* Geol. Soc. America, North-Central Sec., 3d Ann. Mtg. 1969, Field Trip Guidebook: Columbus, Ohio, Ohio Div. Geol. Survey, p. 3-1 — 3-13, illus., 1969.

This field trip provided an opportunity for collecting conodont specimens from the Cincinnati Series (Upper Ordovician) and also to review problems of biostratigraphy of the rocks of the series. Four conodont fauna predominate in the Cincinnati region: *Panderodus gracilis*, *Rhipidognathus symmetricus*, *Phragmodus undatus*, and *Amorphognathus* (including *Ambalodus*). Representatives of these Cincinnatian fauna are very much alike at any of the levels of their occurrence, since evolutionary development was apparently very slow during Upper Ordovician. The Cincinnatian sections have been correlated primarily by matching conodont faunal tongues. — EH

Bhandhausavee, Choosin. *See* Nielson, F. Dwayne. 09056

08873 **Bhattacharyya, B. K.** Treatment and interpretation of high-resolution aeromagnetic data for detailed geological mapping [abs.]: Geophysics, v. 34, no. 6, p. 998, 1969.

09130 **Bishop, William F.** Environmental control of porosity in the upper Smackover Limestone, North Haynesville field, Claiborne Parish, Louisiana, *in* Geology of the American Mediterranean: Gulf Coast Assoc. Geol. Socs. Trans., v. 19, p. 155-169, illus., 1969.

Regionally, Smackover porosity is confined to a coastal shelf where calcarenites with primary intergranular porosity were widespread and a shelf slope where sediments were largely confined to local shoals resulting from contemporaneous uplift. A cal-

carenite bar along the seaward edge restricted circulation. Because of hypersalinity, Smackover allochems are mostly nonskeletal; deposition resembled that of the Bahama Banks. Slight differential structural movement permitted turbulence in local areas which produced clean, well-sorted calcarenite with excellent porosity, much of which was destroyed through cementation with sparry calcite. Evidence of compaction is common in the reservoir; early cementation and migration of oil prevented excessive compaction. Lower energy mixed facies environment produced poor porosity which was further reduced by pressure solution. — *from* Author's abstract

09108 **Black, Robert F.** Slopes in southwestern Wisconsin, U.S.A., periglacial or temperate,?: Biul. Peryglacjalny, no. 18, p. 69-82, illus., discussion, 1969.

The study analyzes quantitatively mass-movement rates and effect of frost action on particulates on slopes on Ordovician dolomites and Cambrian sandstones in the "Driftless Area" near Madison, Wis. Alternate freezing and thawing were found to move surface stones downslope very rapidly; spring and fall wetting and drying moved soil particles almost as much; movement of large blocks depended on their size and degree of slope but were generally slower. In test areas total net displacement of soil downslope on a 25° slope averaged 5 mm per yr or approximately 200 cm per 1,000 yr. Average 10°-20° slopes in the area should have erosion rates of 20-100 cm per 1,000 yr. Calculating from the last significant periglacial climate of 15,000-20,000 yr ago, a total of 3-15 m material may have been removed from the slopes. Most slopes were formed during the present temperate climate. — EH

01459 **Blackadar, R. G.** Precambrian geology, northwestern Baffin Island, District of Franklin (47 E, F, G, H; 48 A, B, C, D; 57 E, H; 58 A, D) [with French abs.]: Canada Geol. Survey Bull. 191, 89 p., illus., tables, geol. map, 1970.

Exploration in northern Baffin Island early in this century disclosed a thick succession of volcanic rocks and unfossiliferous clastic and carbonate strata overlying a gneissic complex; gold, silver, platinum, lead, and zinc were reported. Reconnaissance studies in 1954 established the stratigraphic succession for these rocks and overlying Paleozoic strata and extended their known outcrop pattern some distance inland. In 1963 the Precambrian formations of northwestern Baffin Island were mapped in detail. The gneissic complex, mainly leucocratic granitic textured gneisses, is overlain by a thick succession comprising the Eqalulik (volcanic succession, quartzite sequence) and Uluksan (shale, dolomite, limestone, mudstone, siltstone, sandstone) Groups and possible equivalents along the shores of Fury and Hecla Strait. All Precambrian rocks are intruded by gabbro dikes, in swarms most commonly trending northwest. — *from* Author's abstract

01630 **Blackford, M. E.; Major, M. W.; Butler, D. L.** Strain steps from the nuclear explosion MILROW [abs.]: EOS, v. 51, no. 3, p. 203, 1970.

Blake, M. C., Jr. *See* Bailey, E. H. 09123

09058 **Blystone, Jerome R.; Smith, Preston C.** Development of a high-velocity impact test for laboratory compaction of granular materials — Discussion [of paper by R. P. Dove, T. G. Williamson, and H. R. J. Walsh, 1969]: Highway Research Rec. 284 (Natl. Acad. Sci. Pub. 1661), p. 49, 1969.

Dove and others (ibid., p. 37-48) have made a thorough evaluation of the developed compaction apparatus, but Blystone and Smith suggest that the steepness of the HVI compaction curves on the dry side of optimum moisture content may be partially due to a cause not discussed. The authors state that after compaction, the entire sample is removed, weighed, and oven dried. They do not state that water was lost during compaction, but it seems that progressively more may have been lost from each successive specimen, and some correction to the laboratory value needs to be made. — ESL

Boettcher, A. L. *See* Hill, Robin E. T. 01781

01721 **Boggs, Sam, Jr.; Baldwin, Ewart M.** Distribution of placer gold in the Sixes River, southwestern Oregon — A preliminary report: U.S. Geol. Survey Bull. 1312-I, p. I1-I27, illus., tables, 1970.

Analysis of 158 samples from Sixes River for gold content shows that gold in particles larger than 0.15 mm is concentrated mainly in the South Fork with less in the Middle Fork, Hays Creek, and main stream between Hays Creek and South Fork. Minor amounts of finer gold are in all tributaries. Most coarse gold appears to come from quartz veins and small diorite dikes in argillites of the Galice Formation, and some finer gold from conglomerates and sandstones in Otter Point and Rocky Point Formations and the Umpqua Formation. Tenor of placer gold increases with increase in size of particles rather than in number of smaller particles. Both size and content of gold decrease in the river below South Fork; in the lower 8-10 miles, concentration is 1 ppb, averaging less than 0.15 mm. Coarser gold appears to lag behind in the upper reaches. — GDC

08924 **Bohidar, N. K.; Willson, J. E.** Stress distribution around a cylindrical opening under uniaxial compression and lateral confinement [abs.]: Mining Eng., v. 21, no. 12, p. 60, 1969.

01679 **Bolt, Bruce A.; Niazi, Mansour; Somerville, M. R.** Diffracted ScS and the shear velocity at the core boundary: Royal Astron. Soc. Geophys. Jour., v. 19, no. 3, p. 299-305, illus., tables, 1970.

SH waves from the surface-focus Iranian earthquake of August 31, 1968, have been analyzed to study the structure at the base of the mantle. The long-period E-W component records from western North American stations recorded essentially only the SH polarized wave as a pulse; high frequency but less energetic precursors (perhaps SKS) were also present. For a radius of 3,479 km, the S velocity at the boundary is 6.99 ± 0.10 kmps, which suggests a slight velocity decrease downwards at the mantle bottom. Values of log A/T show a monotonic decrease with distance for $\Delta = 100°$-114°. The unadjusted SH amplitude attenuation for period 35 sec is -0.065 (1n A versus $\Delta°$). The frequency spectra of waves do not seem to vary with distance at low frequencies as predicted by simple diffraction theory for a homogeneous mantle. — *from* Author's summary

01694 **Bonatti, Enrico; Ball, Mahlon; Schubert, Carl.** Evaporites and continental drift: Naturwissenschaften, v. 57, no. 3, p. 107-108, illus., 1970.

Summarized data strongly support the idea that evaporite deposits were formed during the early development of the Atlantic rift. Evaporite deposits have been discovered in the Atlantic and adjacent to it in several localities within a climatic belt compatible with deposition by evaporation. Their age, when known, is close to that inferred for the opening of the proto-Atlantic; thus, the evaporites from the South Atlantic appear to be younger than those from the northern hemisphere. — DBV

01596 **Booth, James S.** Sediment dispersion in northern Channel Island passages, California [abs.]: Am. Assoc. Petroleum Geologists Bull., v. 54, no. 3, p. 557, 1970.

01739 **Borg, I. Y.** Mechanical < 110 > twinning in shocked sphene [abs.]: EOS, v. 51, no. 4, p. 424, 1970.

09020 **Borg, I. Y.; Smith, D. K.** Calculated X-ray powder patterns for silicate minerals: Geol. Soc. America Mem. 122, 896 p., illus., tables, 1969.

Suggestions and ideas from many individuals have been incorporated into the long-time study and the computer program used to produce the X-ray patterns given in this memoir. Part 1 includes principles of calculation of powder patterns, calculation of tables, criteria for selection of structural analyses, interpretation, silicate classification and organization, and references. Part 2 lists the minerals included in 42 tables, explains the organization of the tabulated powder pattern data and the terms and abbreviations used, and presents the tabulated results, concluding with a list of five strongest peaks in calculated patterns. — GDC

08979 **Bostock, H. H.** Precambrian rocks of Deer River map-area, Manitoba (54E, F, K, L): Canada Geol. Survey Paper 69-24, 37 p., illus., tables, geol. map, 1969.

In this area, oldest Precambrian rocks include acid to basic volcanic and sedimentary rocks mostly in the almandine-amphibolite metamorphic facies. Hybrid rocks derived from these were formed during emplacement of plutonic rocks ranging from quartz diorite to granite. K-Ar age determinations on muscovite and biotite from a granodiorite on South Knife River are 1,660 and 1,670±55m. y., respectively. Folded clastic sediments of presumably younger Precambrian age have undergone greenschist facies metamorphism. Aeromagnetic anomaly patterns suggest that diabase of the Mackenzie dike swarm intrudes the granitic rocks. Precambrian rocks are unconformably overlain by nearly flat-lying, predominantly lower Paleozoic carbonate rocks. Two occurrences of fluorite in granitic rocks are reported; a calcareous metasiltstone bearing laminae of hyalophane and uvarovite with associated chromite is described. — *from* Author's abstract

01740 **Bottinga, Y.; Weill, D. F.** Viscosity of anhydrous silicate melts [abs.]: EOS, v. 51, no. 4, p. 439, 1970.

01741 **Bottino, Michael R.; Fullagar, Paul D.; French, Bevan M.** Rb-Sr study of shock-metamorphosed inclusions from the Onaping Formation, Sudbury, Ontario [abs.]: EOS, v. 51, no. 4, p. 433, 1970.

01626 **Boucher, Gary W.; Ryall, Alan; Homuth, E. F.; Savage, W. U.** Strain and field-seismic observations of effects due to the Nevada underground nuclear test JORUM [abs.]: EOS, v. 51, no. 3, p. 203, 1970.

01697 **Boyle, R. W.; Garrett, R. G.** Geochemical prospecting, a review of its status and future: Earth-Sci. Rev., v. 6, no. 1, p. 51-75, 1970.

A brief review of the history of geochemical prospecting is given and the various methods are described and discussed. The present and future applications are mentioned, with discussion of the advantages and drawbacks. Emphasis is laid on the ever-increasing future possibilities for the utilization of chemical methods. An extensive review of the relevant literature is given. — Authors' summary

Brace, W. F. *See* Byerlee, J. D. 01743

01409 **Brace, William F.; Ernst, W. G.; Kallberg, Razel Wittels.** An experimental study of tectonic overpressure in Franciscan rocks: Geol. Soc. America Bull., v. 81, no. 5, p. 1325-1338, illus., tables, 1970.

Approximately 4 kb tectonic overpressure was required by one theory for the formation of jadeite-aragonite-bearing rocks of the Franciscan. Strength of two common Franciscan rocks — massive graywacke and thin-bedded shale and graywacke — was determined at 4 kb confining pressure and 200° to 300°C, in the presence of aqueous pore fluid. The strength was found to depend markedly on both pore and total pressures. The required tectonic overpressure could only have been generated in massive graywacke, and only when pore pressure was less than hydrostatic. With even moderate amounts of interbedded shale, tectonic overpressure could not have exceeded 1 kb. — *from* Author's abstract

01742 **Brace, William F.** Some effects of high temperature on the frictional sliding of granite [abs.]: EOS, v. 51, no. 4, p. 423, 1970.

Brace, William F. *See* Wawersik, Wolfgang R. 01848

01670 **Brack, Sheila D.** On a new structurally preserved arborescent lycopsid fructification from the Lower Pennsylvanian of North America: Am. Jour. Botany, v. 57, no. 3, p. 317-330, illus., 1970.

Bisporangate lycopsid fructifications are described from petrifaction material of Pottsville (Lower Pennsylvanian) age collected in eastern Kentucky. The largest specimen of *Lepidosstrobus schopfi*, sp.n. is 8.0 cm long and approximately 1.3 cm in diam.; it is not complete at either apex or base. Basal megasporangia, each containing a variable number (12-29) of megaspores, and apical microsporangia are adaxially

positioned on pedicels bearing reduced lateral laminae. Features of the cone axis and pattern of vascularization are described. Of particular interest is the occurrence of well-preserved endosporic megagametophytes showing archegonia and rhizoids. The new species is compared to other structurally preserved bisporangiate lycopsid fructifications of equivalent age. — Author's abstract

01728 **Bradshaw, Peter M. D.; Clews, D. Richard; Walker, John L.** Exploration geochemistry — Pt. 2, Detailed surveys: Mining in Canada, February 1970, p. 22-32, illus., 1970.

This is the second article in a series of seven dealing with the principles and uses of geochemistry in mineral exploration. The previous article (December 1969 issue) described the general principles of geochemical dispersion. The present article discusses the use of the different stages in detailed geochemical follow-up based on these principles. Topics covered include reconnaissance stream sediments, preliminary and detailed follow-up stream sediments, and bank, soil, profile soil, and bedrock sampling. — GV

09052 **Brady, J. G.; Collings, R. K.; Reeves, J. E.; Stonehouse, D. H.** Canadian minerals for ceramics: Canadian Ceramic Soc. Jour., v. 38, p. 123-136, tables, 1969.

Deposits of minerals useful to the ceramic industry are relatively common in Canada. The development of many has been restricted by such factors as limited markets, exacting specifications, transportation costs, difficulties of beneficiation, and the entrenchment of certain imported minerals. Canadian fire clays, stone-ware clays, bentonites and common clays and shales are used domestically, but at present no developed sources of china clay exist in Canada. Deposits of nepheline syenite, feldspar, silica, limestone, dolomite, sodium sulphate, and kyanite are being utilized. Pyrophyllite, talc, spodumene, gypsum, barite, and fluorspar occur without present ceramic production, but there is possibility of increased development. — *from* Authors' abstract

Brady, Nyle C. *See* Buckman, Harry O. 08950

Bramlette, M. N. *See* Bukry, David. 09121

01660 **Braun, Moshe; Friedman, Gerald M.** Dedolomitization fabric in peels, a possible clue to unconformity surfaces: Jour. Sed. Petrology, v. 40, no. 1, p. 417-419, illus., 1970.

Thin sections and stained peels of dedolomite under plane polarized light may reveal a crystalline limestone devoid of ghosts of dolomite rhombs, but if exactly the same area is viewed under crossed nicols, the dolomite ghosts may become evident. These ghosts are diagnostic of dedolomitization. Peels are normally black under crossed nicols because the acetate is isotropic. Etching may bring out solubility differences between calcite crystals making up the matrix of dedolomite and those in the original rhombs. During peel preparation, the micron-sized crystals occupying the original rhombs may become attached to the surface of the peel and hence show up as anisotropic substance demarcating the dolomite rhombs as ghosts. Not all peels of dedolomite show dolomite rhombs under crossed nicols. — *from* Authors' abstract

Bray, E. E. *See* Davis, J. B. 09111

01675 **Bray, J. R.** Solar activity index — Validity supported by oxygen isotope dating: Science, v. 168, no. 3931, p. 571-572, table, 1970.

A significant correlation between oxygen-18 concentration in a Greenland ice core and an index of solar activity supports the validity of the solar index. The correlation may result from an apparent control of temperature by solar activity. — Author's abstract

01718 **Bredehoeft, John D.; Young, Robert A.** The temporal allocation of ground water, a simulation approach: Water Resources Research, v. 6, no. 1, p. 3-21, illus., 1970.

Users of ground water are typically interdependent in that withdrawals affect the conditions of water supply experienced by neighboring pumpers. Previous attempts to consider the problem have used a simplified model for the ground-water system that assumes response to uniformly distributed withdrawals; but in developing systems, large differences in drawdown commonly occur. A more realistic model has been incorporated into a simulation program representing a ground-water basin system. Effects of two policy instruments, a use tax and a quota, were investigated for a hypothetical basin in an arid region of irrigated farming; unrestricted use was compared with regulation for several alternative aquifer developments. Policies that reduced the rate of withdrawal increased the discounted net economic yield. — *from* Authors' abstract

Breed, William J. *See* Mamay, Sergius H. 01474

01640 **Brewer, P. G.; Spencer, D. W.; Wilkniss, P. E.** Anomalous fluoride concentrations in the North Atlantic: Deep-Sea Research, v. 17, no. 1, p. 1-7, illus., tables, 1970.

Fluoride analyses have been carried out on sea water samples from 33 stations in the North Atlantic [cruises across Puerto Rico Trench and on to Nares Abyssal Plain, Gibraltar-Azores-Wood Hole, and Woods Hole-Sargasso Sea-Woods Hole]. Samples of deep water at two localities gave indications of anomalously high fluoride concentration when analyzed colorimetrically, but no anomalous indication when measured with fluoride specific ion electrode. Anomalous samples were further analyzed by photon activation and found indeed to have high concentrations of fluoride. This combination of high concentration and normal sea water activity suggests that excess fluoride is either chemically complexed or in colloidal form. These hypotheses are examined and the colloidal phenomenon is suggested as the more likely. — *from* Authors' abstract

Brimhall, G. *See* Wenk, H. R. 01870

Brockman, Stanley R. *See* Engdahl, Eric R. 01631

Brookins, D. G. *See* Laughlin, A. W. 01792

Brooks, C. *See* Krogh, T. E. 01614

01615 **Brooks, C.; Hart, S. R.** Discussion of the use of Rb-Sr isochron regression treatments: Carnegie Inst. Washington Year Book 68, 1968-69, p. 413-417, illus., 1970.

01616 **Brooks, C.; Krogh, T. E.; Hart, S. R.; Davis, G. L.** Carbonate contents and Sr-87/Sr-86 ratios of calcites from Archaean metavolcanics: Carnegie Inst. Washington Year Book 68, 1968-69, p. 420-422, illus., 1970.

01617 **Brooks, C.; Krogh, T. E.; Hart, S. R.; Davis, G. L.** The initial Sr-87/Sr-86 ratios of the upper and lower series, Michipicoten metavolcanics, Ontario, Canada: Carnegie Inst. Washington Year Book 68, 1968-69, p. 422-425, illus., 1970.

01618 **Brooks, C.; Hart, S. R.; Krogh, T. E.; Davis, G. L.** Initial Sr-87/Sr-86 ratios of regionally sampled metavolcanics from the Canadian shield: Carnegie Inst. Washington Year Book 68, 1968-69, p. 425-426, illus., 1970.

Brooks, C. *See* Hart, S. R. 01619

Brooks, C. *See* Hart, S. R. 01620

08869 **Brower, James C.** Crinoids, Chap. 12 *in* History of the Redwall Limestone of northern Arizona: Geol. Soc. America Mem. 114, p. 475-543, illus., table, 1969.

About 200 identifiable crinoids, all camerates except for 2 inadunates, are present in the Redwall Limestone. Forty-five species are recognized, identifiable to varying degrees of certainty. Only calices and dorsal cups are known, and most are molds in chert. Most in the Thunder Springs or Mooney Falls Members are of Osage and Meramec Series. — HRC

09063 **Brown, Jerry.** Soil properties developed on the complex tundra relief of northern Alaska: Biul. Peryglacjalny, no. 18, p. 152-167, illus., 1969.

A 5-year investigation of coastal plain tundra near Barrow, Alaska, evaluated soil variations, surface relief, and near-surface lithology in a region underlain by continuously frozen ground. Analysis of 80 one-m cores showed no statistical correlation between microrelief and thaw or microrelief and moisture. A negative correlation was found between thaw depth and total moisture in seasonally thawed soil. Maximum average thaw at each of 80 points was 52 cm. Climatic records showed that the summers of 1951 and 1954 were wet and warm enough to produce a 52-cm thaw. Chemical analyses of soils from 3 to 5-m cores showed a vertical depression of chemical concentrations beneath part of the 1.5-km study transect, suggesting previous occurrence of a lake. A wide range of C-14 ages of buried peat at the seasonally thawed-perennially frozen ground interface and lack of textural unconformities suggest cryopedologic burial of the peat. — EH

08874 **Brown, R. J. E.** Permafrost and ground ice features of the sedimentary basins in the Canadian Arctic [abs.]: Geophysics, v. 34, no. 6, p. 999, 1969.

Brown, Thomas H. *See* Helgeson, Harold C. 08942

01565 **Brumund, William Frank.** Subsidence of sand due to surface vibration [abs.]: Dissert. Abs. Internat., Sec. B, Sci. and Eng., v. 30, no. 9, p. 4122B, 1970.

Brune, James N. *See* Thatcher, Wayne. 09116

Bryant, William R. *See* Pyle, Thomas E. 09131

Buckham, James A. *See* Slansky, Cyril M. 09036

08950 **Buckman, Harry O.; Brady, Nyle C.** The nature and properties of soils (7th edition, revised by N. C. Brady): New York, Macmillan Co., 653 p., illus., tables, 1969.

Among numerous advances in the field of soil science since 1960, when the sixth edition of this book was published, the most dramatic change has been the adoption in the United States of a new comprehensive system of soil classification, relating class names to soil properties rather than to soil genesis, but not ignoring genetic processes. Of the 21 chapters, those geologically oriented are: (1) soil in perspective (mineral and organic constituents); (3) some important physical properties of mineral soils; (4) soil colloids; (6) organic matter of mineral soils; (11) the origin, nature, and classification of parent materials; (12) soil formation, classification and survey; (13) organic soils — nature, properties and utilization; and (14) soil reactions. — GDC

Buckmeier, F. J. *See* Purvis, A. E. 09011

Bucknam, R. C. *See* McKeown, F. A. 01629

01581 **Bufe, Charles Glenn.** An estimate of the configuration of the surface of the Earth's core from the consideration of surface focus PcP travel times [abs.]: Dissert. Abs. Internat., Sec. B, Sci. and Eng., v. 30, no. 9, p. 4211B-4212B, 1970.

09121 **Bukry, David; Bramlette, M. N.** Coccolith age determinations — Leg 1, Deep Sea Drilling Project, *in* Initial reports of the Deep Sea Drilling Project — V. 1, Leg 1 of cruises of *Glomar Challenger*, Orange, Tex., to Hoboken, N. J., Aug.-Sept. 1968: Washington, D.C., U.S. Govt. Printing Office, p. 369-387, illus. [1969?].

Over 400 coccolith samples were investigated by electron-microscope and light-microscope techniques. Following a brief summary of the coccolith stratigraphy for each drilling site, age-diagnostic species in selected samples are listed, and the geologic ages determined are summarized graphically. Electron micrographs of 42 coccoliths are included. — ESL

08967 **Bullen, K. E.** Seismic and related evidence on compressibility in the Earth, *in* The application of modern physics to the earth and planetary interiors (S. K. Runcorn, editor): London and New York, Wiley-Interscience, p. 287-297, table, 1969.

The derivation of values of k (incompressibility) in the Earth is obtained and reference is made to the simple behavior of k and dk/dp at pressures beyond 0.4 $\times 10^{12}$ dyn/cm^2 and to Earth models which embody the main results. Applications of compressibility theory to questions of estimation of density gradients in inhomogeneous regions and the solidity of the inner core are examined also. The bearing of Birch's results on this discussion are surveyed, and revisions of earlier work necessitated by the recently changed estimate of the Earth's moment of inertia and current work on free oscillation data are examined. Evidence favors a steady increase of dk/dp with depth in the Earth's core from about 3 units at the top to at least 4 and possibly 5 or 6 units at the center. — VSN

09025 **Burbank, Wilbur S.; Luedke, Robert G.** Geology and ore deposits of the Eureka and adjoining districts, San Juan Mountains, Colorado: U.S. Geol. Survey Prof. Paper 535, 73 p., tables, geol. maps, 1969.

The Eureka base- and precious-metal mining district includes a 30-sq-mi area of chiefly Tertiary volcanic rocks in the central and northeastern parts of the structurally complex Silverton cauldron. The great variety of eruptive rocks and associated intrusive masses throughout the area were intensely altered propylitically and locally solfatarically. Two major types of mineral deposits occur within the district: (1) vein deposits, related to crustal distention and collapse of the cauldron, and (2) chimney or pipelike deposits more typical of the cauldron's peripheral ring-fault zone. These types of deposits are compared with respect to their different origin, evolution, structure, and ore and gangue mineralogy. — WSB

01432 **Burch, Stephen H.; Durham, David L.** Complete Bouguer gravity and general geology of the Bradley, San Miguel, Adelaida, and Paso Robles quadrangles, California: U.S. Geol. Survey Prof. Paper 646-B, p. B1-B14, illus., tables, geol. map, 1970.

The granitic and metamorphic Salinian block, constituting the basement of the central and greatest part of this oil-producing area is separated from the adjacent Franciscan basement by the San Andreas fault in the northeast and the Nacimiento fault in the southwest; overlying both blocks is a sequence of Cretaceous and Tertiary marine deposits and the nonmarine Paso Robles Formation. Major gravity features of the Salinian block include Hames Valley low, San Ardo oil-field high, Vineyard Canyon low, Cholame Hills high, and transverse Indian Valley fault. Inferred basement structures suggest three unexplored areas favorable to oil accumulation. Gravity data suggest that in the Paso Robles area, Jolon fault, rather than Nacimiento fault, marks the contact of the Franciscan and granitic basement blocks, and that Jolon fault probably joins Rinconada fault to the south. — *from* Authors' abstract

Burford, Robert O. *See* Savage, James C. 01827

Burk, Creighton A. *See* Ewing, Maurice. 09110

Burnett, D. S. *See* Eugster, O. 01701

08961 **Burns, R. G.** Optical absorption in silicates, *in* The application of modern physics to the earth and planetary interiors (S. K. Runcorn, editor): London and New York, Wiley-Interscience, p. 191-211, illus., tables, 1969.

Absorption spectra of ferromagnesian silicates measured at atmospheric pressure and room temperature are described, effects of pressure and temperature on the spectra are discussed, and possible applications of the spectral data to processes occurring in the mantle are suggested. Spin pairing in Fe^{2+} ion in oxide phases of the lower mantle can lead to reduced magnetic susceptibility, and high-spin to low-spin transitions in iron of orthopyroxenes in the transition zone could catalyze breakdown of orthopyroxenes to olivine plus stishovite. Pressure-induced increases of crystal-field splittings indicate that crystal-field stabilization energies of transition-metal ions

increase with depth in mantle, electronic absorption bands in the infrared indicate that ferromagnesian silicate minerals in the upper mantle may act as thermal insulators of radiation from the lower mantle, and intense absorption of radiation in visible and near infrared by charge-transfer bands may seriously affect heat balance near the core-mantle boundary. — VSN

Burrell, D. C. *See* Sharma, G. D. 01421

Butler, D. L. *See* Blackford, M. E. 01630

01692 **Byerlee, J. D.; Peselnick, L.** Elastic shocks and earthquakes: Naturwissenschaften, v. 57, no. 2, p. 82-85, illus., 1970.

Experimental results show that sudden crack growth does give rise to elastic shocks during application of stress to a rock, but that cracks also can grow stably without generating detectable high-frequency "seismic" energy. Elastic shocks are produced during unstable sliding between two surfaces of brittle materials; thus, unstable sliding between grain boundaries and(or) on crack surfaces may be an important source of elastic shocks during compressive loading of brittle rocks. In the experiments, shocks were produced both on loading and unloading. Large-scale motion on natural faults presumably occurs as a result of continuous application of tectonic stresses; when stresses relax, movement in the reverse direction could occur if sufficient elastic energy had been stored in the surrounding material during the previous deformation. This might explain occasional earthquakes in seemingly stable regions. — DBV

01743 **Byerlee, J. D.; Brace, W. F.** Modification of sliding characteristics by fluid injection and its significance for earthquake prevention [abs.]: EOS, v. 51, no. 4, p. 423, 1970.

01566 **Byrne, Peter Michael.** Elastic-viscoplastic response of earth structures to earthquake motion [abs.]: Dissert. Abs. Internat., Sec. B, Sci. and Eng., v. 30, no. 9, p. 4122B, 1970.

Cable, Lewis W. *See* Daniel, James F. 01489

Cabrera, José G. *See* Smalley, Ian J. 01502

01744 **Cadle, Richard D.** Variation in the nature of particles in Kilauea volcanic fume [abs.]: EOS, v. 51, no. 4, p. 440, 1970.

Cameron, K. L. *See* Bence, A. E. 01738

01387 **Canada Geological Survey.** Aeromagnetic series, Sheets 16 K/5 and K/6, 16K/11 and 16 K/12, 16 K/13 and K/14, Baffin Island, District of Franklin: Canada Geol. Survey Geophysics Papers 5434-5436, scale 1:63,360, 1970.

01388 **Canada Geological Survey.** Aeromagnetic series, Sheet 16 N/3 and 16 N/4, Baffin Island, District of Franklin: Canada Geol. Survey Geophysics Paper 5437, scale 1:63,360, 1970.

01389 **Canada Geological Survey.** Aeromagnetic series, Sheet 16 L/1 and Sheet 16 L/2 and part of 16 K/4, Baffin Island, District of Franklin: Canada Geol. Survey Geophysics Paper 5438, scale 1:63,360, 1970.

01390 **Canada Geological Survey.** Aeromagnetic series, Sheets 16 L/7 and 16 L/8, 16 L/9 and 16 L/10, 16 L/15 and 16 L/16, 16 L/3 and 16 L/4, 16 L/5 and 16 L/6, 16 L/11, and 16 L/12, 16 L/13 and 16 L/14, Baffin Island, District of Franklin: Canada Geol. Survey Geophysics Papers 5439-5447, scale 1:63,360, 1970.

01391 **Canada Geological Survey.** Aeromagnetic series, Sheets 16 M/1 and 16 M/2, 16 M/7 and 16 M/8, 16 M/3 and 16 M/4, 16 M/5 and 16 M/6, 16 M/11 and 16 M/12, Baffin Island, District of Franklin: Canada Geol. Survey Geophysics Papers 5442-5443, 5448-5450, scale 1:63,360, 1970.

01392 **Canada Geological Survey.** Aeromagnetic series, Sheets 26 L/1 and 26 L/2, 26 L/7 and 26 L/8, 26 L/9 and 26 L/10, 26 L/15 and 26 L/16, Baffin Island, District of Franklin: Canada Geol. Survey Geophysics Papers 5516-5519, scale 1:63,360, 1970.

01393 **Canada Geological Survey.** Aeromagnetic series, Sheets 26 M/1 and 26 M/2, 26 M/7 and 26 M/8, 26 M/9 and 26 M/10, 26 M/15 and 26 M/16, 26 M/3 and 26 M/4, 26 M/5 and 26 M/6, 26 M/11 and 26 M/12, 26 M/13 and 26 M/14, Baffin Island, District of Franklin: Canada Geol. Survey Geophysics Papers 5520-5523, 5528-5531, scale 1:63,360, 1970.

01394 **Canada Geological Survey.** Aeromagnetic series, Sheets 27 B/3, 27 B/6, 27 B/11, 27 B/14, 27 B/4, 27 B/5, 27 B/12, 27 B/13, Baffin Island, District of Franklin: Canada Geol. Survey Geophysics Papers 5524-5527, 5532-5533, scale 1:63,360, 1970.

01395 **Canada Geological Survey.** Aeromagnetic series, Sheets 36 P/1 and 36 P/2, 36 P/7 and 36 P/8, 36 P/9 and 36 P/10, 36 P/15 and 36 P/16, Baffin Island, District of Franklin: Canada Geol. Survey Geophysics Papers 5536-5539, scale 1:63,360, 1970.

01396 **Canada Geological Survey.** Aeromagnetic series, Sheets 37 A/1, 37 A/8, 37 A/9, 37 A/16, 37 A/7 and part of 37 A/2, 37 A/10, 37 A/15, 37 A/11, 37 A/14, Baffin Island, District of Franklin: Canada Geol. Survey Geophysics Papers 5540-5548, scale 1:63,360, 1970.

01397 **Canada Geological Survey.** Aeromagnetic series, Bonavista, Newfoundland: Canada Geol. Survey Geophysics Paper 7047, scale 1:253,440, 1970.

01398 **Canada Geological Survey.** Aeromagnetic series, Wesleyville, Newfoundland: Canada Geol. Survey Geophysics Paper 7347, scale 1:253,440, 1970.

01399 **Canada Geological Survey.** Aeromagnetic series, Botwood, Newfoundland: Canada Geol. Survey Geophysics Paper 7348, scale 1:253,440, 1970.

01400 **Canada Geological Survey.** Aeromagnetic series, Sandy Lake, Newfoundland: Canada Geol. Survey Geophysics Paper 7349, scale 1:253,440, 1970.

01401 **Canada Geological Survey.** Aeromagnetic series, Bay of Islands, Newfoundland: Canada Geol. Survey Geophysics Paper 7350, scale 1:253,440, 1970.

01402 **Canada Geological Survey.** Aeromagnetic series, Port Saunders, Newfoundland: Canada Geol. Survey Geophysics Paper 7357, scale 1:253,440, 1970.

01403 **Canada Geological Survey.** Aeromagnetic series, St. Anthony, Newfoundland: Canada Geol. Survey Geophysics Paper 7366, scale 1:253,440, 1970.

01404 **Canada Geological Survey.** Aeromagnetic series, McBeth Fiord, District of Franklin, Northwest Territories: Canada Geol. Survey Geophysics Paper 7956, scale 1:253,440, 1970.

01405 **Canada Geological Survey.** Aeromagnetic series, Lake Gillian, District of Franklin, Northwest Territories: Canada Geol. Survey Geophysics Paper 7957, scale 1:253,440, 1970.

01406 **Canada Geological Survey.** Aeromagnetic series, Conn Lake, District of Franklin, Northwest Territories: Canada Geol. Survey Geophysics Paper 7978, scale 1:253,440, 1970.

01407 **Canada Geological Survey.** Aeromagnetic series, Buchan Gulf, District of Franklin, Northwest Territories: Canada Geol. Survey Geophysics Paper 7999, scale 1:253,440, 1970.

01458 **Canada Geological Survey.** Physiographic regions of Canada: Canada Geol. Survey Map 1254A, scale 1:5,000,000, 1970.

Caner, B. *See* Niblett, E. R. 08960

01572 **Carlson, Marvin Paul.** Stratigraphic framework of Precambrian and lower and middle Paleozoic rocks in the subsurface of Nebraska [abs.]: Dissert. Abs. Internat., Sec. B, Sci. and Eng., v. 30, no. 9, p. 4205B, 1970.

01453 **Carmichael, Dugald M.** Intersecting isograds in the Whetstone Lake area, Ontario: Jour. Petrology, v. 11, no. 1, p. 147-181, illus., tables, 1970.

The four successively higher isograds defined in an area of Precambrian metamorphic rocks near Whetstone Lake — staurolite-biotite, hyanite-biotite, sillimanite, and sillimanite-garnet-biotite isograds — three are intersected by a Ca-amphibole-K-feldspar isograd in a manner that can be explained in terms of mixing of water and carbon dioxide. The reactions involved indicate a significantly higher H_2O/CO_2 fugacity ratio in the vicinity of the granitic pluton intruding the pelitic and calcareous rocks. — MS

01865 **Carmichael, Dugald M.; Trzcienski, W. E., Jr.** Matrix analysis of metamorphic reactions [abs.]: EOS, v. 51, no. 4, p. 445, 1970.

Carmichael, I. S. E. *See* Peterman, Zell E. 01698

01456 **Carskedden, Jeff.** A petrographic study of flint from aboriginal quarrying sites in southeastern Ohio [abs.]: Denison Univ. Sci. Lab. Jour., v. 50, art. 1-4, p. 22-23, 1969 [1970].

01745 **Carter, Bruce.** Structure of the San Gabriel anorthosite massif, California [abs.]: EOS, v. 51, no. 4, p. 446, 1970.

08927 **Cartwright, K.; Sherman, F. B.** Groundwater and engineering geology in siting on sanitary landfills [abs.]: Mining Eng., v. 21, no. 12, p. 58, 1969.

Causey, J. D. *See* Laughlin, A. W. 01792

Causey, J. D. *See* Laughlin, A. William. 01793

09033 **Cecil, Lawrence K.** (editor). Water, 1969 — Chem. Eng. Prog. Symposium Ser., No. 97, V. 65: New York, Am. Inst. Chem. Engineers, 315 p., illus., tables, 1969.

Systems analysis and total environment are magic phrases in the pollution control field. Engineers are often accused of being so obsessed with numbers as to tend to solve an immediate problem without proper regard for the effect of the solution on the world environment. Of the 43 papers in this volume, the first four and the tenth by R. B. Dean, A. M. Piper, R. C. Routson and R. E. Wildung, C. M. Slansky and J. A. Buckham, respectively, are cited separately. Others deal with pollution and purification of stream waters, and methods of control, of interest to chemical engineers. One consistent theme is to bring to the concerned public new developments in treating methods, hoping to accelerate the reduction of pollution in the environment. — GDC

09002 **Cedergren, Harry R.** Geological considerations in the design of reservoir seepage control systems, *in* Reservoir leakage and groundwater control: Assoc. Eng. Geologists Bull., v. 6, no. 1, p. 61-69, illus., 1969.

When water is stored in reservoirs, the hydraulic head that is built up causes the water to seek out every geologic flaw and every previous soil layer that will help it to escape to lower elevations. Even very minute soil and geologic details have been the cause of serious seepage conditions, including the total failure of dams and reservoirs. Designing systems to control seepage from reservoirs requires the combined, concentrated efforts of both geologists and engineers. This paper presents examples to demonstrate the importance of the careful evaluation of geologic conditions at individual reservoir sites. It also emphasizes the need for designing drainage systems with adequate discharge capacities to handle unexpectedly large flows through hidden previous joints, seams, and other water-conducting channels in the foundations and rims of reservoirs. — Author's abstract

09122 **Čepek, Pavel; Hay, William W.** Calcareous nannoplankton and biostratigraphic subdivision of the Upper Cretaceous, *in* Geology of the American Mediterranean: Gulf Coast Assoc. Geol. Socs. Trans., v. 19, p. 323-336, illus., 1969.

Twelve calcareous nannofossil zones are recognized in the Cenomanian-Maastrichtian interval of Upper Cretaceous. Four zones are within the Cenomanian-Turonian interval, another four within the Coniacian-Santonian, and four within the Campanian-Maastrictian. Many genera and species evolved during Cenomanian, and increase in diversity is a marked feature of Cenomanian and Turonian assemblages. Evolution proceeded rapidly in some groups during Coniacian-Santonian. Campanian was a period of relative evolutionary quiescence and is difficult to subdivide. Maastrichtian is characterized by successive elimination of many species and decreasing diversity. The end of Maastrichtian coincides with an abundance-diversity minimum marking a great change in calcareous nannoplankton fossil assemblages. Reference sections for the zones are in Kansas and Alabama. — *from* Authors' abstract

01595 **Chambers, Charles E.** California digital mapping [abs.]: Am. Assoc. Petroleum Geologists Bull., v. 54, no. 3, p. 557, 1970.

01658 **Chan, K. M.; Manheim, F. T.** Interstitial water studies on small core samples, Deep Sea Drilling Project, Leg 2, [Chap.] 15 *in* Initial reports of the Deep Sea Drilling Project — V. 2, Leg 2 of cruises of *Glomar Challenger*, Hoboken, N. J., to Dakar, Senegal, Oct.-Nov. 1968: Washington, D. C., U.S. Govt. Printing Office, p. 367-371, tables, 1970.

Chloride concentrations in interstitial waters of drill cores from the North Atlantic cluster about 19.7 percent and vary with depth from less than 1 percent to about 2 percent through Upper Cretaceous sediments. Ionic proportions in the pore waters are closest to those in the present open ocean in the central part of the ocean, and become progressively more divergent as the continents and terrigenous influences are approached. Magnesium is generally depleted in the presence of clayey or siliceous sediments, except in dolomitic sediments; potassium is frequently enriched in the upper sediment column. Except for boron, minor element concentrations (strontium, barium, magnesium, lithium) increase on approaching the continents. — Authors' conclusions

Chao, E. T. C. *See* Bell, Peter M. 01736

09049 **Chao, G. Y.** Refinement of the crystal structure of parahopeite [with German abs.]: Zeitschr. Kristallographie, v. 130, nos. 4-6, p. 261-266, illus., tables, 1969.

The crystal structure of parahopeite, $Zn_3(PO_4)_2 4H_2O$, has been refined using three-dimensional intensity data. The refined atomic positions obtained in this paper provided more regular coordination polyhedra with interatomic distances in better agreement with those found in other compounds. — Author's abstract

01570 **Charles, Michel.** Velocity and stress distributions in the Earth's mantle due to secular variation of the geomagnetic field [abs.]: Dissert. Abs. Internat., Sec. B, Sci. and Eng., v. 30, no. 9, p. 4154B, 1970.

Chase, Clement G. *See* Larson, Roger L. 01699

01455 **Chayes, Felix.** On estimating the magnitude of the hidden zone and the compositions of the residual liquids of the Skaergaard layered series: Jour. Petrology, v. 11, no. 1, p. 1-14, illus., tables, 1970.

Application of numerical solutions to available data on the composition and relative magnitude of zones in the exposed part of the Skaergaard complex, as well as to data on the composition of the parent magma, results in estimates of a considerably larger unexposed zone than the relative magnitude estimates derived by graphical solutions. Compositional computations of successive residual liquids indicated essentially no end-stage alkali enrichment. — MS

01746 **Chen, Ju-chin.** Some chemical aspects of eclogites [abs.]: EOS, v. 51, no. 4, p. 447, 1970.

Chilman, Ruth B. *See* Stumm, Erwin C. 09102

01706 **Chitale, Shrikrishna V.** River channel patterns: Am. Soc. Civil Engineers Proc., v. 96, paper 7038, Jour. Hydraulics Div., no. HY 1, p. 201-221, illus., tables, 1970.

River channel patterns of various types are described and defined. Data for 42 rivers are collected in respect to meander and channel characteristics. Relationships are statistically determined between tortuosity ratio and important channel characteristics. Similar equations are evolved for the ratio of meander belt to channel width. These two ratios define shape and size of a meander. Conditions when channels become straight or meandering are described, and it is shown that meandering helps the channel to reach final stability. — ASCE abstract

Chodos, A. A. *See* McGetchin, T. R. 01799

Christ, Charles L. *See* Hostetler, Paul B. 01783

01747 **Church, Stanley E.; Tilton, G. R.** Lead and strontium isotopes and their bearing on the genesis of andesitic magmas in the Cascades [abs.]: EOS, v. 51, no. 4, p. 442, 1970.

01748 **Clark, Bruce R.** Stress-controlled orientation of microlites in obsidian [abs.]: EOS, v. 51, no. 4, p. 425, 1970.

Clayton, Robert N. *See* Muehlenbachs, Karlis. 01804

Clews, D. Richard. *See* Bradshaw, Peter M. D. 01728

08915 **Clibbon, Peter Brooke.** The nature, evolution and present extension of the ecumene in the shield section of the Saint-Maurice Valley (Québec): Cahiers Géographie Québec, v. 13, no. 28, p. 5-33, illus., 1969.

The geology and soils of the Saint-Maurice Valley, Quebec, are discussed in general terms as a background for the history of settlement of the area, its land use patterns, agriculture, and industry. This glaciated platform, deeply cut into flat-topped massifs and rounded hills separated by narrow, flat-bottomed valleys, has a thick cover of blue-gray marine clays over bedrock of gneiss and paragneiss intruded by granite, gabbro, and anorthosite, and also some thin beds of sands and silts, and thick sand and gravel accumulations at the mouths of some rivers. A map of faults and shear zones shows the Saint-Maurice fault which transects the area as a 50-mile-long valley occupied by elongated lakes, creeks and small rivers. — EH

Coale, Burton V. *See* Miller, Pat H. 09026

Cobban, W. A. *See* Gill, J. R. 01430

01749 **Coe, Robert S.** Thermodynamic effect of shear stress on inversion in enstatite [abs.]: EOS, v. 51, no. 4, p. 435, 1970.

09093 **Coker, A. E.; Marshall, R.; Thomson, N. S.** Application of computer processed multispectral data to the discrimination of land collapse (sinkhole) prone areas in Florida, *in* Symposium on remote sensing of environment, 6th Internat., Ann Arbor, Mich., 1969, Proc., V. 1: Ann Arbor, Mich., Univ. Michigan, Willow Run Labs., p. 65-77, illus., table, 1969.

The U.S. Geological Survey and the Infrared and Optics Laboratory of the University of Michigan jointly collected data near Bartow, Fla., to study land collapse phenomena using remote-sensing techniques. Data obtained using the multispectral scanner system consisted of combinations of 18 spectral bands from 0.4-14 microns and several types of photography. Since areas prone to active sink collapse often are not detectable from surface expressions of hydrology and geology prior to collapse,

an experiment was conducted to test the hypothesis that areas of active sinks could be detected at land surface from effects of water loss at depth on vegetation physiology and terrane temperatures. Processed multispectral data showed that terrane temperature patterns, when compared with moisture-stressed vegetation patterns, show distinctive patterns which correlate with areas of known sinkhole activity in the Bartow area. — *from* Author's abstract

01605 **Colburn, Ivan P.; Rodine, James.** Paleocurrent and basin analysis of Late Cretaceous "Chico" Formation, Simi Hills, California [abs.]: Am. Assoc. Petroleum Geologists Bull., v. 54, no. 3, p. 562, 1970.

Coleman, R. G. *See* Sainsbury, C. L. 01464

Collings, R. K. *See* Brady, J. G. 09052

01750 **Combs, Jim; Simmons, Gene.** Heat flow in north central United States [abs.]: EOS, v. 51, no. 4, p. 426, 1970.

01751 **Condie, Kent C.; Barsky, Constance K.** The origin of Sr-depleted basalts [abs.]: EOS, v. 51, no. 4, p. 443, 1970.

Cone, G. C. *See* Lovering, T. G. 01461

Conkin, Barbara M. *See* Conkin, James E. 01648

01648 **Conkin, James E.; Conkin, Barbara M.** Middle Devonian arenaceous foraminifera of central Ohio — Pt. 1, Revision of the genus *Webbinelloidea* Stewart and Lampe, 1947: Micropaleontology, v. 16, no. 1, p. 1-14, illus., 1970.

The genus *Webbinelloidea* Stewart and Lampe, 1947, is revised following a study of the types of Stewart and Lampe (1947) and Summerson (1958), and of specimens subsequently collected by the authors from the Middle Devonian limestones of central Ohio. All the forms reported from the Middle Devonian of Ohio by Stewart and Lampe (1947) and Summerson (1958), which we refer herein to *Webbinelloidea*, are placed in the type species, *W. similis* Steward and Lampe, 1947. Four morphological groups with subgroups are recognized within *W. similis*. *Sorosphaeroidea* Stewart and Lampe, 1947, is a junior synonym of *Webbinelloidea* Stewart and Lampe, 1947, by the action of the first revisers, Loeblich and Tappan (1964). — Authors' abstract

08974 **Cook, A. H.** Gas lasers and the measurement of long period and secular changes, *in* The application of modern physics to the earth and planetary interiors (S. K. Runcorn, editor): London and New York, Wiley-Interscience, p. 505-512, illus., 1969.

The application of an interferometer with a gas laser source to measure strain is explained, and the possible accuracy that may be obtained and difficulties to be overcome in making a reliable strain gage are considered. Problems associated with measurements over a long period of time, a few days to a year or more, are emphasized. — VSN

Cook, Frances. *See* Hays, James D. 01429

Cook, Harry. *See* Hays, James D. 01429

09001 **Coombs, Howard A.** Leakage through buried channels, *in* Reservoir leakage and groundwater control: Assoc. Eng. Geologists Bull., v. 6, no. 1, p. 45-52, illus., 1969.

In the Puget Sound area, Wash., glacial movements drastically altered drainage channels over a short period of time (11,000-14,000 yr). New superposed channels cutting through outwash veneer and into bedrock provide attractive damsites. Old, buried drainage channels nearby may afford an escape route for reservoir water. Tolt River dam, 30 mi east of Seattle, is in an entrenched river with andesite flows forming the bottom and glacial drifts the sides of the valley. Leakage through glacial material in the old channel was sealed by an impervious blanket. At Sultan dam, 35 mi

northeast of Seattle, the buried channel was filled with till which formed an effective seal against leakage and also supplied material for the impervious core of the dam. At Gorge dam on the Skagit River, 22 mi south of the Canadian border, in order to prevent water from the old reservoir, 400 feet upstream, from moving into the new, deep excavation, a frozen subsurface seal 220 feet in height was installed. — *from* Author's abstract

Cooper, J. R. *See* Lovering, T. G. 01461

Copeland, C. W. *See* Powell, W. J. 01427

Copeland, C. W. *See* Powell, W. J. 01611

01684 **Coughran, Edward H.** Shipboard computers: Oceanology Internat., v. 5, no. 2, p. 28-31, illus., 1970.

Shipboard computers were initially concerned with solution of basic problems in physical oceanography and magnetic or gravity surveys. Today they are used also to assist in navigation of deep towed bodies in conjunction with acoustical beacons or transponders on the ocean floor; assist in local navigation of subsurface vessels, dead reckoning, satellite navigation, bathymetric mapping; and for collecting input data for weather and water temperature forecasting. Computers range from small special-purpose instrument packages designed for a single experiment or class of experiments to general-purpose computers. Examples are cited of some types of computers and their application to scientific programs. — VSN

Cowperthwaite, Michael. *See* Petersen, Carl F. 01446

Cray, E. J., Jr. *See* Mudie, J. D. 01413

01484 **Croft, Mack G.; Wesolowski, E. A.** Transmissivity and storage coefficient of aquifers in the Fox Hills Sandstone and the Hell Creek Formation, Mercer and Oliver Counties, North Dakota, *in* Geological Survey research 1970, Chap. B: U.S. Geol. Survey Prof. Paper 700-B, p. B190-B195, illus., table, 1970.

Since 1963, about 100 flowing stock and domestic wells have been drilled into the Fox Hills Sandstone and the Hell Creek Formation in Mercer and Oliver Counties, N. Dak. Aquifer tests were made on about half of the wells. The values obtained for transmissivity range from 13 to 3,100 gallons per day per foot, and average 510 gallons per day per foot. An analysis of the potentiometric surface in the southwestern part of Mercer County indicates a transmissivity of about 1,400 gallons per day per foot. The values for permeability average 16 gallons per day per square foot. Data indicate storage coefficient values are between 10^{-4} and 10^{-3}. The aquifer tests indicate that the wells have specific capacities that range from less than 0.1 to 0.6 gallon per minute per foot. — Authors' abstract

01752 **Crosby, Gary W.** Tectonic models for structural regimes [abs.]: EOS, v. 51, no. 4, p. 430-431, 1970.

01753 **Cruden, D. M.** A theory of the static fatigue of rock under uniaxial compression [abs.]: EOS, v. 51, no. 4, p. 424, 1970.

01492 **Culbertson, J. K.; Scott, C. H.** Sandbar development and movement in an alluvial channel, Rio Grande near Bernardo, New Mexico, *in* Geological Survey research 1970, Chap. B: U.S. Geol. Survey Prof. Paper 700-B, p. B237-B241, illus., 1970.

Sonic sounder records were used to document the development and movement of transverse bars in the Rio Grande conveyance channel near Bernardo, N. Mex. Rate of movement was about 350 and 370 feet per day for two transverse bars observed. Depth of flow was less and velocity of flow was greater over the bars than in the dune reaches, but the water-surface slopes were equal. Median size of bed-surface material on the backs of bars was finer than the bed-surface material in the dune reaches. The mechanics of formation and movement of transverse bars is obscure; however, the

bars may be formed by the coalescence of large dunes, and movement is caused by scour of the bar at the upstream end and deposition at the downstream end. A natural sorting of bed material at the upstream end of the bar is also indicated. — Authors' abstract

01754 **Cullers, R. L.; Medaris, L. G., Jr.; Haskin, L. A.** Rare-earth partition between aqueous fluid, silicate minerals, and silicate glasses [abs.]: EOS, v. 51, no. 4, p. 451, 1970.

08912 **Cullins, Henry L.** Geologic map of the Mellen Hill quadrangle, Rio Blanco and Moffat Counties, Colorado: U.S. Geol. Survey Geol. Quad. Map GQ-835, scale 1:24,000, section, text, 1969.

The Rangely oil field, part of which lies in the Mellen Hill quadrangle, produces oil in this quadrangle from the Mancos Shale and the Weber Sandstone. The thickest coal bed (6.2 feet) occurs in the main coal unit of the Mesaverde Group in the southwestern section. Oil shale occurs in the Parachute Creek Member of the Green River Formation; sand and gravel are obtained from terrace deposits for use on county roads. The largest structural feature other than Rangley anticline is the Blue Mountain thrust fault in the north; oil or gas may be trapped somewhere along the subthrust plate. — MCM

08852 **Curray, Joseph R.** Shore zone sand bodies — Barriers, cheniers, and beach ridges, Lecture 2 *in* The new concepts of continental margin sedimentation, application to the geological record — AGI short course lecture notes, Philadelphia, 1969: Washington, D. C., Am. Geol. Inst., p. JCII-1—JCII-18, illus., 1969.

The shore zone is the surface or potential surface of deposition of paralic facies sediments or marginal marine sediments. In this discussion, special attention is paid to beach and nearshore processes and to the formation and origin of barriers, cheniers, and beach ridges. Coastlines can be classified into transgressive, stable, or regressive, and various examples are cited of each. The most recent events of the Pleistocene, sea advance and barrier building, especially, are related to this, being in part the reworking of the transgressive-deposition of sand; all barriers, however, are not so formed. All areas seem to be different and conditions change with time. Geologically, the Holocene is a bit unusual in that all of the coastlines are in process of recovering from transgression and equilibrium is being sought. — HRC

08853 **Curray, Joseph R.** Estuaries, lagoons, tidal flats, and deltas, Lecture 3 *in* The new concepts of continental margin sedimentation, application to the geological record — AGI short course lecture notes, Philadelphia, 1969: Washington, D. C., Am. Geol. Inst., p. JCIII-1—JCIII-30, illus., 1969.

Estuarine circulation, the occupation of the same area by both fresh and/or salt water, is dependent upon many factors: salt wedges, nonsilled or deepsilled estuaries, silled estuaries and fjords, and inverse estuaries. From a discussion of the nature of the sediment deposition in estuaries, lagoons, tidal flats, and deltas, it is concluded that the environments of the shore zone are complex and interrelated, and that they vary widely in kind and scale as a function of the numerous complex environmental factors. It is difficult to generalize about the shore zone sediments and principles of deposition. — HRC

08858 **Curray, Joseph R.** Shallow structure of the continental margin, Lecture 12 *in* The new concepts of continental margin sedimentation, application to the geological record — AGI short course lecture notes, Philadelphia, 1969: Washington, D. C., Am. Geol. Inst., p. JCXII-1—JCXII-22, illus., 1969.

Several morphologic types are recognized on the continental margin: the shelf rise, bordering depression, continental borderland, marginal plateau type, and steep rift type. All are products of differing types of structures associated with sedimentary deposits and do not include deep, fundamental continental crustal or mantle features. Extensive reflection seismic work has shown considerable internal details of the sediments within the shelves. Tectonic structures, as well as erosional features,

have been recognized in some, but most shelves are depositional, and are upbuilding and/or outbuilding or entrapping behind some sort of structural dam. The ultimate controlling factors are tectonism, sedimentation, and eustatic sea-level changes. — HRC

08919 **Curray, Joseph R.** History of continental shelves, Lecture 6 *in* The new concepts of continental margin sedimentation, application to the geological record — AGI short course lecture notes, Philadelphia, 1969: Washington, D. C., Am. Geol. Inst., p. JCVI-1—JCVI-18, illus., 1969.

Opinions on Holocene transgression range from one continuous overlap to one of multiple fluctuations. There is general agreement over the existence of fluctuations during the Quaternary, although details vary from author to author. Since shelf-facies muds of continental origin are not taken far out on the shelf, the widespread distribution of sediments must be from deposition during transgression and subsequent reworking by present-day equilibrium-seeking processes. The morphology of the present shelf is a result of the pretransgression topography, modified by erosion and sedimentation before, during, and after the Holocene transgression. In pre-Quaternary shelves, one would not expect to find abrupt, sharp shelf breaks, and without eustatic sea-level changes, uniformity of depth would not be probable. — HRC

Currie, D. G. *See* Alley, C. O. 08908

09125 **Daneš, Zdenko F.** Gravity results in western Washington, *in* Symposium on gravity surveys in western North America (David F. Barnes, editor): EOS, v. 50, no. 10, p. 548-551, illus., 1969.

About 5,000 gravity measurements have been made in western Washington since 1962 by the University of Puget Sound, for the primary purpose of distinguishing the large-scale geophysical features of the mountains and lowlands of western Washington; secondary objectives were more detailed analyses of specific geologic faults, intrusions and lava flows. The resulting Bouguer anomaly map includes the following features: (1) the Cascade Low has minimums of -180 mgal close to the Canadian border, trending south with a nonuniformly decreasing relief until in the vicinity of Oregon it diminishes to about -75 mgal, (2) the Puget Sound low has a minimum of -125 mgal in the vicinity of Seattle, (3) the Coast Range High has a maximum of +50 mgal near the Oregon border, extending northward to the southern foothills of the Olympic Mountains, and (4) the Olympic Low has a minimum of -80 mgal and is elongated WNW along the structural axis of the Olympic Mountains. — GV

01489 **Daniel, James F.; Cable, Lewis W.; Wolf, Ronald J.** Ground water-surface water relation during period of overland flow, *in* Geological Survey research 1970, Chap. B: U.S. Geol. Survey Prof. Paper 700-B, p. B219-B223, illus., 1970.

The ground-water exchange mechanism at the stream interface during periods of overland runoff was investigated by means of observation wells installed in the flood plain on the White River near Noblesville, Ind. Ground-water discharge decreases with beginning of a stream rise, ceases after a short time interval, and then bank storage occurs. A volume of discharge from the aquifer equal to that which entered as bank storage at the study site was dissipated 54 hours after an overbank peak, 42 hours after a medium peak and 50 hours after a small peak. Results were used to formulate a theoretical method for stream-hydrograph separation of base and overland flow. The separation method shows no ground-water runoff until bank storage and channel storage volumes have been dissipated; all discharge in the stream before and after this period is equal to that contributed by the aquifer system. — *from* Authors' abstract

01645 **Davidson, E. S.; Weist, W. G., Jr.** Geohydrology, *in* Objectives, methods, and environment — Gila River Phreatophyte Project, Graham County, Arizona: U.S. Geol. Survey Prof. Paper 655-A, p. A8-A11, illus., 1970.

The Gila River valley northwest of Stafford is filled with fine, thin-bedded sediments, dissected by channels filled with coarse, thick or crossbedded alluvium. Drainage

from bordering highlands flows to the river and its associated alluvial deposits, the water collected moving northwestward; that within the basin fill flows toward lower terrace and floodplain alluvium and upward in it under pressure in wells along the river. Terrace alluvium, exposed on both sides, also fills the deep trough cut by the Gila River; lithologically similar floodplain alluvium, in shallower troughs cut into terrace alluvium, is distinguished chiefly by topographic position. The top of it is 5 to 8 m below top of terrace alluvium and 1.5 m above the Gila River bed. Infiltration of surface water to alluvium is probably larger and more variable in time than groundwater flow in basin fill. — GDC

Davies, D. *See* King, G. C. P. 08975

01541 **Davies, David K.; Moore, W. Richard.** Dispersal of Mississippi sediment in the Gulf of Mexico: Jour. Sed. Petrology, v. 40, no. 1, p. 339-353, illus., tables, 1970.

Three distinct sediment input sources may be recognized for detrital sediments in the Gulf of Mexico abyssal plain: (1) the Mississippi, (2) the Rio Grande, and (3) the rivers of northeast Mexico. The Mississippi input is dominant everywhere but in the northwest and southwest corners of the abyssal plain. Because of the insensitivity of the heavy mineral assemblage of the Mississippi contribution to processes of selective sorting and reworking, only 200 nonopaque grains from one size fraction of one sample are needed to characterize this contribution. — *from* Authors' abstract

09053 **Davis, Douglas; Ellis, Howard; Rase, Daniel E.** Adirondack anorthosite — A potential ceramic raw material [for] fast fired tile: Canadian Ceramic Soc. Jour., v. 38, p. 19-23, illus., 1969.

An attempt was made to develop a fast-fired, essentially one-component, ceramic tile composed almost entirely of Adirondack anorthosite. Test specimens were dry pressed from mixtures of crystalline anorthosite grog and various anorthosite-flux frits. The fired samples were evaluated on the basis of appearance, strength, absorption, and total shrinkage. Several compositions are reported which, when fired as low as 1000°C for only five minutes, developed physical properties comparable to commercially produced ceramic tile. — Authors' abstract

Davis, G. L. *See* Krogh, T. E. 01614

Davis, G. L. *See* Brooks, C. 01616

Davis, G. L. *See* Brooks, C. 01617

Davis, G. L. *See* Brooks, C. 01618

Davis, G. L. *See* Hart, S. R. 01620

Davis, G. L. *See* Krogh, T. E. 01789

09111 **Davis, J. B.; Bray, E. E.** (compilers, and others). Analyses of oil and cap rock from Challenger (Sigsbee) Knoll, *in* Initial reports of the Deep Sea Drilling Project — V. 1, Leg 1 of cruises of *Glomar Challenger*, Orange, Tex., to Hoboken, N. J., Aug.-Sept. 1968: Washington, D. C., U.S. Govt. Printing Office, p. 415-500, illus., tables [1969?].

Analyses of Deep Sea Drilling Project Cores 5 and 6, Leg 1, Site 2, indicate that oil exists in a normal cap rock environment. Core 5 has calcite at the top with calcite and sulfur at the base; Core 6 is gypsum. A low-gravity, high-sulfur oil contained in the upper part of Core 5 is compared with Gulf Coast Tertiary oils; it is believed to be young and of marine origin. The calcite-sulfur zone at the bottom of Core 5 contains 19 percent elemental sulfur. Origin of the free sulfur is discussed. C-13 abundance in calcite identifies the calcite carbon as originating in cap rock oil. Cap rock is thought to form from insoluble residues that collect on top of salt domes as the salt is dissolved. A number of these assemblages were found in the knoll. Crystal form, relationships, and associations of calcite, gypsum, and sulfur are similar to Gulf Coast cap rock. — *from* Authors' abstract

09086 **Davis, Stanley N.** Porosity and permeability of natural materials, Chap. 2 *in* Flow through porous media (R. J. M. DeWiest, editor): New York and London, Academic Press, p. 53-89, illus., tables, 1969.

Reliable values of porosity and permeability can rarely be estimated on the basis of general geologic knowledge alone. Extent of this knowledge is reviewed, relating it to more analytical discussions in subsequent chapters. Materials considered here are: dense rocks such as granite, dolerite, quartzite, slate and gabbro; volcanic rocks such as basalt flows, near surface intrusions, and pyroclastics; indurated sedimentary rocks including shales, variable sandstones, and carbonate rocks; and nonindurated sediments such as alluvial, eolian, glacial, and fine-grained of diverse origin. Typical values are tabulated for these, and for dense rocks modified by fracturing and weathering; relations to depth and effects of solution are discussed briefly. Disaggregated sediments in drill cuttings or laboratory size-analyses may be highly misleading for permeability conclusions. — GDC

Davis, T. E. *See* Sinha, A. K. 01833

09034 **Dean, Robert B.** Ultimate disposal of waste water — A philosophical view, *in* Water, 1969 (L. K. Cecil, editor) — Chem. Eng. Prog. Symposium Ser., No. 97, V. 65: New York, Am. Inst. Chem. Engineers, p. 1-4, 1969.

A proper understanding of ultimate disposal shows that there is no storage place that can be considered ultimate disposal for everything. The best that we can do is to put the individual elements back where they were before they started their long journey to the sewage treatment plant. This means carbon dioxide back via the atmosphere to the immense buffer system of the ocean, nitrogen back to the nitrogen gas in the atmosphere, calcium back to the land or stones, etc. The ocean is ultimate disposal for sodium chloride, but it is not ultimate disposal for DDT or mercury salts. — Author's abstract

08957 **Dearnley, R.** Crustal tectonic evidence for Earth expansion, *in* The application of modern physics to the earth and planetary interiors (S. K. Runcorn, editor): London and New York, Wiley-Interscience, p. 103-110, illus., 1969.

Precambrian crustal geotectonic data are outlined which support suggested continental drift reconstructions and which could be interpreted as evidence for expansion of the Earth, based on investigation of distribution of dated geosynclinal orogenic fold belts. If incidence of metamorphic and igneous activity associated with orogenic belts is correctly represented by the frequency distribution of age determinations, then variations in activity throughout geologic time may be deduced. The fold belts which comprise the Superior regime are dominantly concordant in any given region, and continental reconstructions indicate fold belts within this time in an essentially parallel arrangement and confirm the general predrift 'fit' of continents. Fold belts of the Precambrian regimes fit into a two-cell convection pattern modified by force of the Earth's rotation. Estimates are made of rate of expansion assuming a 4400 km radius for the Superior regime. — VSN

01647 **Deep Sea Drilling Project.** (East Coast Repository). Leg 2 grain size analysis and composition of the coarse fraction, [Chap.] 8 *in* Initial reports of the Deep Sea Drilling Project — V. 2, Leg 2 of cruises of *Glomar Challenger*, Hoboken, N. J., to Dakar, Senegal, Oct.-Nov. 1968: Washington, D. C., U.S. Govt. Printing Office, p. 307-317, illus., tables, 1970.

Methods of analysis were described in the core descriptions for Leg 1. In this report, descriptions of the cores from Leg 2 are given by sites, and complete results of the grain-size analyses and a summary of the composition of the coarse fraction are tabulated. Results of the analyses are correlated with the nature of the sediments in Hole 10. — ESL

09037 **Deiler, Frederick G.** Freeport Sulphur Company's pollution control program (special reference to offshore), *in* Water, 1969 (L. K. Cecil, editor) — Chem. Eng. Prog. Symposium Ser., No. 97, V. 65: New York, Am. Inst. Chem. Engineers, p. 53-63, illus., tables, 1969.

This company operates five mines in the Gulf coastal area of Louisiana. At each, the Frasch process of mining is used, necessitating the constant removal of formation water at the flanks of the dome; it is known as bleed-water and totals millions of gallons per day. Permits to discharge this waste into state water courses are obtained from the Louisiana State Stream Control Commission. The company operates a program of surveillance consisting of water sampling for chemical analyses (dissolved oxygen, sulfides, salinity, and *p*H and temperature measurements) and comprehensive quarterly surveys employing chemical, physical, and biological parameters. Various types of sampling equipment are described. — *from* Author's abstract

Dellwig, L. F. *See* MacDonald, H. C. 09014

09039 **Dellwig, Louis F.** An evaluation of multifrequency radar imagery of the Pisgah Crater area, California: Modern Geology, v. 1, no. 1, p. 65-73, illus., table, 1969.

The Pisgah Crater test site has been imaged by several different radar systems. Although simultaneous imaging by K-, C-, and P-band radars has not been realized, cautious comparisons (recognizing the influence of variation in system and surface parameters) of available, nonsimultaneously recorded imagery point to the value of simultaneous imaging by long and short wavelength systems. The imagery evaluated has well documented the wavelength dependence of the return signal from some cultural and natural phenomena. Variations in return were primarily a function of surface roughness although some penetration by long wavelength radar was also demonstrated. — Author's abstract

08947 **Denison, Robert H.** New Pennsylvanian lungfishes from Illinois: Fieldiana — Geology, v. 12, no. 12, p. 193-211, illus., 1969.

Status of American species previously referred to *Conchopoma* is reviewed; only the type, *C. gadiforme* Kner, from Germany, is well enough known to be characterized satisfactorily. *C. edesi* n.sp. is described herein from several nearly complete specimens from the Francis Creek Shale east of Mazon Creek, in Peabody Coal Co. Pit 11, Will-Kankakee Counties, Ill. The most characteristic feature of *Conchopoma* is the presence of many small, closely spaced teeth on the anterior parts of the parasphenoid and pterygoids instead of the typical dipnoan tooth plates. Unusual features of *C. edesi* are: a median subrectangular lower tooth plate borne by the anterior end of the hyoid arch; marginal teeth in the lower jaws, a primitive character; and extremely long, slender paired fins. Two incomplete heads of very small, undetermined juvenile Dipnoi are described from the same locality. — VMJ

09084 **DeWiest, Roger J. M.** (editor). Flow through porous media: New York and London, Academic Press, 530 p., illus., tables, 1969.

At this National Science Foundation-sponsored Institute in Hydrology for College Teachers, Princeton University, 1965, lectures dealt with ground-water and surface-water hydrology, hydrogeology, and open channel flow. Lectures included in this volume, as a textbook or supplement to assigned reading for graduate students, cover material related only to subterranean flow. The eleven chapters include: fundamental principles of ground-water flow, porosity and permeability of natural materials, resistance to flow through porous media, hydrodynamic dispersion, velocity and longitudinal dispersion, flow in unsaturated soils, transient free-surface flow, elastic storage in aquifers, generating functions in theory of flow, Green's functions, and flow of immiscible liquids. Lectures by R. J. M. DeWiest, S. N. Davis, and H. J. Morel-Seytoux are cited separately. — GDC

09085 **DeWiest, Roger J. M.** Fundamental principles of ground-water flow, Chap. 1 *in* Flow through porous media (R. J. M. DeWiest, editor): New York and London, Academic Press, p. 1-52, illus., 1969.

Discussed here in relation to ground water are: Darcy's Law of laminar flow; introduction of Hubbert's force potential; equations of ground-water flow and storage coefficient (redefining its relation with specific storage as the result of integration of the equation of flow over thickness of the aquifer) and derivations considered with conservation of mass, transformation, and homogeneous, isotropic medium; poten-

tial flow, with constant hydraulic gradient, in wells, and "method of images;" mathematical techniques in potential flow, based on conformable mapping, and the hodograph; the factor of leaky aquifers; dispersion; and flow of a nonhomogeneous fluid in a porous medium, with determination of point-water, fresh-water, and true environmental-water heads. — GDC

Dicke, R. H. *See* Alley, C. O. 08908

Dickey, D. D. *See* McKeown, F. A. 01629

01428 **Dickinson, William R.** The new global tectonics — 2d Penrose Conference: Geotimes, v. 15, no. 4, p. 18-20, 22, 1970.

Stated topic for the Geological Society of America's second Penrose Conference, Pacific Grove, Calif., was "The meaning of the new global tectonics for magmatism, sedimentation, and metamorphism in orogenic belts." Reported here are preparations for it; caliber of the 95 invited participants; need for thinking about orogeny in a truly global context; concepts shared in the week of semiformal and informal sessions, dominated by the plate-tectonics model; a new term "subduction zone" applied to any elongate region of crustal deformation; discussion of intracontinental thrust belts of andesitic volcanic chains, and granitic batholithic belts; interpretation of the origin of ophiolite and peridotite-gabbro complexes; history of the San Andreas Fault; and finally, difficulties with the traditional geosynclinal theory of orogeny. — GDC

01755 **Dieterich, James H.** Time dependence in stick-slip sliding [abs.]: EOS, v. 51, no. 4, p. 423, 1970.

09055 **Dietz, Robert S.** The underwater landscape, *in* Exploring the ocean world (C. P. Idyll, editor): New York, Thomas Y. Crowell Co., p. 22-41, illus., 1969.

This paper reviews the exploration of the ocean floor from 1521 when Magellan tried to measure its depth with a rope to modern sonic-, or echo-sounding methods and deep-sea research vehicles which have made possible detailed mapping of the floor. The author describes the structure of the ocean basins, which are exposures of the Earth's mantle. The ocean floor is constantly in the process of being reshaped by volcanic and tectonic processes which created the ultradeep trenches and high midoceanic ridges, seamounts and sea volcanoes, and also caused sea-floor spreading from the ridges toward the continents. The theory of continental drift is discussed also. — EH

09105 **Dietz, Robert S.** Mineral resources and power, *in* Exploring the ocean world (C. P. Idyll, editor): New York, Thomas Y. Crowell Co., p. 164-195, illus., 1969.

Minerals available in sea water and on the ocean floor and the history and methods of their exploration and exploitation are reviewed. Water and its salts, extracted chiefly by evaporation and precipitation, are the most valuable sea minerals; desalination of sea water by various methods is a growing industry. Hot brine pools and basic and ultrabasic rocks of the ocean floor are potential sources of minerals. Phosphorite and manganese nodules will probably soon be mined on the ocean floor. Twenty percent of the world's total petroleum reserves are located on the shallow portions of the continental shelf and in the future the deeper areas of the shelves may be exploited. Deep-sea drilling projects, present and potential uses of tidal power, and aspects of international law for dealing with exploitation of ocean resources are discussed. — EH

Diffenbach, Robert. *See* Mauger, Richard L. 01798

01671 **Dilcher, David L.; Dolph, Gary E.** Fossil leaves of *Dendropanax* from Eocene sediments of southeastern North America: Am. Jour. Botany, v. 57, no. 2, p. 153-160, illus., 1970.

As part of the reinvestigation of the Eocene flora from southeastern North America, a leaf form similar to some that were formerly placed in the genus *Aralia* has been identified as *Dendropanax*. Studies of the fine veination and cuticular characters have been important in this identification. This is the first report of leaf material of the genus *Dendropanax* in the fossil record. — Authors' abstract

01722 **Dimroth, Erich.** Meimechites and carbonatites of the Castignon Lake complex, New Quebec: Neues Jahrb. Mineralogie Abh., v. 112, no. 3, p. 239-278, illus., tables, 1970.

The Castignon Lake complex of meimechite and carbonatite dikes and diatremes in northeastern Quebec is post-Hudsonian in age (< 1550 m.y.). Erosion has exposed various sections through the volcanic structures, from the feeder dikes to the base of eruptive cones. Deeper levels of the diatremes are surrounded by breccia zones. The petrography of the rocks is described. Liquid unmixing apparently was an important differentiation mechanism. The primary magma had the composition of a carbonated kimberlite. Different rock varieties developed at different levels. The rocks belong to an alkali-ultramafic suite rich in Fe, Al, Ti, and Ca, with a high potash/soda ratio; they are related to kimberlites but apparently not to nepheline syenites. — DBV

Dinkelman, M. G. *See* Barr, Jim L. 01661

Dodge, F. C. W. *See* Tilling, Robert I. 01411

08948 **Dodge, Harry W., Jr.** The geology of D.A.R. State Park, Mt. Philo State Forest Park, Sand Bar State Park: Montpelier, Vt., Vermont Geol. Survey, 32 p., illus., 1969.

This pamphlet explains how to read the geologic history of the Champlain Valley from its rocks. On the D.A.R. State Park beach, abundantly fossiliferous, tilted layers of the shaly Glens Falls Limestone are clues to an Ordovician sea and its life. The rocks were tilted during the Taconian orogeny, Late Ordovician, and eroded for 300 million years before late Pleistocene glaciation and subsequent damming of Lake Champlain. The summit area of Mt. Philo State Forest Park is primarily Monkton Quartzite (Cambrian) of shallow water origin thrust-faulted over younger Stony Point Shale (Ordovician). Two glacial advances and retreats left striations, rock debris, and proglacial lakes; marine beach gravel west of Mt. Philo indicates an arm of the Atlantic Ocean just prior to present Lake Champlain. Sand Bar State Park is geologically recent, with marine clays covered by delta and sand bar deposits from abandoned Lamoille River. — GDC

Dolph, Gary E. *See* Dilcher, David L. 01671

01493 **Dong, Alex E.** Spectrochemical determination of microgram quantities of germanium in natural water containing high concentrations of heavy metals, *in* Geological Survey research 1970, Chap. B: U.S. Geol. Survey Prof. Paper 700-B, p. B242-B244, illus., tables, 1970.

A procedure is described for the chemical separation and determination of microgram quantities of germanium in water containing high concentrations of heavy metals. Before being subjected to spectrochemical determination, germanium is selectively isolated from other major and minor elements in the water in order to avoid undesirable dilution effects. The average error for eight determinations is ± 9 percent, and the relative standard deviation is 8.0 percent, a level of precision satisfactory for spectrochemical determination of trace quantities of germanium. — Author's abstract

Dooley, J. R., Jr. *See* Szabo, B. J. 01470

09059 **Dove, R. P.; Williamson, T. G.; Walsh, H. R. J.** Development of a high-velocity impact test for laboratory compaction of granular materials: Highway Research Rec. 284 (Natl. Acad. Sci. Pub. 1661), p. 37-48, illus.; closure to discussion, p. 49-50, 1969.

This effort is aimed at development of a laboratory compaction test which can be used without removal of the coarse sizes present, and which will simulate better the effort of modern field equipment. Innovations include larger molds filled in single lifts, a new head that covers the entire surface, and impacts from a vibratory shaker as well as from standard drop-hammers. The moisture-density curves obtained on Indiana granular base and subbase materials are compared to curves from the Standard and Modified Methods, and certain problems of techniques are discussed. It is concluded that the new apparatus could be used to obtain realistic values for such materials. — Authors' abstract

01476 **Downey, Joe S.** Middle Pleistocene Leporidae from the San Pedro Valley, Arizona, *in* Geological Survey research 1970, Chap. B: U.S. Geol. Survey Prof. Paper 700-B, p. B131-B136, illus., table, 1970.

The Curtis Ranch local fauna from near the town of St. David, Ariz., in the San Pedro Valley, contains fossil leporid material assignable to the genera *Aluralagus* and *Lepus*. A new species is described that appears to be related to *Aluralagus bensonensis* of the Benson local fauna. — Author's abstract

08881 **Dowsett, John S.** Thompson mine — A geophysical discovery [abs.]: Geophysics, v. 34, no. 6, p. 1015, 1969.

Drahovzal, J. A. *See* Powell, W. J. 01427

Drahovzal, J. A. *See* Powell, W. J. 01611

Drake, J. J. *See* Ford, D. C. 01726

08899 **Drew, D. P.** Water tracing, *in* Limestone geomorphology, a study in Jamaica: Cave Sci., v. 6, nos. 43-44, p. 96-110, illus., tables, 1969.

During the University of Bristol Expedition in 1967, a series of water traces were carried out to clarify the hydrology of the Maroon Town area and assist in ground-water research in Jamaica. Dyed lycopodium spores were mainly used for tracing underground flow paths, but also, under the tropical conditions, limited experiments were conducted with charcoal grains and an untried pyranine dye, similar to fluorescein but more resistant to absorption on clay or silt and not readily decolorized by strong sunlight. Complexity of drainage pattern in the Tangle River basin required both methods to clarify the subsurface hydrology; their use together in the same test caused no mutual interference, but selection of suitable swallets to test was very difficult. Dye transit times and distances from sinks to risings indicate that subsurface drainage connections change with variations in ephemeral stream flow. — GDC

Drewes, Harald. *See* Lovering, T. G. 01461

Duane, David B. *See* Meisburger, Edward P. 09128

08980 **Dufour, Jules.** Les terrasses du bassin de Saint-Raymond [Terraces of the Saint-Raymond Basin]: Cahiers Géographie Québec, v. 13, no. 28, p. 113-120, illus., 1969.

The Saint-Raymond Basin in Quebec Province, which lies between the Laurentide platform and the Saint Lawrence lowlands, is a depression filled with porous materials and medium- to large-grained sands of a glaciofluvial delta, which is cut by two river valleys into four terrace levels. The upper, or Gosford, level, the original surface of the delta, has medium to coarse sands. Under it lies the Bourg-Louis terrace, a thick layer of well-drained crystalline gravel. On the Chute-Panet terrace, sands and gravel form a thin cover over Champlain clays. Organic soils, peat bogs, and conifer forests are widespread. The Saint-Raymond alluvial plain terrace has alluvial soils and a high ground-water level. — EH

08865 **Duncan, Helen.** Bryozoans, Chap. 7 *in* History of the Redwall Limestone of northern Arizona: Geol. Soc. America Mem. 114, p. 345-433, illus., tables, 1969.

More than 30 species in at least 19 genera of Bryozoa are present in the Redwall Limestone; most are now. *Fenestella* is by far the most prevalent genus in the collections. In spite of the poor quality, the fauna is illustrated and commented upon, although formal paleontological discussion is being reserved for later action after collateral Bryozoa studies from material from the central interior is completed. Material is present from only the middle of the formation. About half of the Redwall bryozoans occur in Osagean rocks of the east-central interior. The rocks of the Redwall, based on bryozoan paleoecology, were not deposited in nearshore or very turbulent shallow-water environments. — HRC

08996 **Dunn, David E.; Weigand, Peter W.** Geology of the Pilot Mountain and Pinnacles quadrangles, North Carolina: North Carolina Div. Mineral Resources Geol. Map Ser. 1, scale 1:24,000, 1969.

08933 **Duong, Phan Kiêu.** Skarns et minéralisations associées — Pt. 1, Généralites sur les skarns; Pt. 2, Principales minéralisations liées-aux skarns [with English and Russian abs.]: Chronique Mines et Recherche Minière, v. 37, no. 387, p. 291-311, illus., 1969; ibid., no. 388, p. 339-362, illus., 1969.

Skarns and associated mineral deposits are reviewed. In Pt. 1, terminology, constituent and accessory minerals, and genesis are discussed. Skarns are of three types: 1) formed by local exchange of elements at the contact between carbonate and aluminum silicate rocks in areas of regional metamorphism; 2) formed in carbonate rocks by massive transport of mineralizing elements associated with intrusion by acid or intermediate plutons; and 3) mixed type, with characters of 1 and 2. Economic deposits are most commonly associated with type 2; types 1 and 3 may contain scheelite deposits. In type 2, three successive, superposed phases are differentiated: silicate, ferruginous, and sulfide-bearing hydrothermal. In Pt. 2, about 40 deposits of scheelite, molybdenite, tin, beryllium, iron, copper, zinc, lead, and gold are described as examples; about half of these are in western North America. — VMJ

Durham, David L. *See* Burch, Stephen H. 01432

01719 **Eargle, D. Hoye.** Recent developments in uranium in South Texas: South Texas Geol. Soc. Bull, v. 10, no. 6, p. 3-6, illus., 1970.

Since 1966 detailed exploration for uranium has been carried on from East Texas to the Rio Grande, chiefly by closely-spaced drilling and logging in stratigraphic units known to be good host rocks — permeable sands in Tertiary tuffaceous formations: Whitsett Formation, Frio Clay and Catahoula Tuff, Oakville Sandstone and Fleming Formation, and Goliad Sand. Sands of the first are shallow marine, littoral and lagoonal; the others are fluviatile. Zones where highly permeable sands grade laterally to less-permeable finer-grained materials, as along boundaries of old channels, are considered favorable sites for ore deposition. Structures followed are chiefly strike faults and salt domes; most producing deposits have been found near faultline oil and gas fields, and one large deposit above a salt dome was precipitated where hydrocarbon seepages create a reducing environment. — GDC

01756 **Eastwood, R. L.** Origin of basaltic andesites of the Tucson Mountains-Roskruge Mountains region, Arizona [abs.]: EOS, v. 51, no. 4, p. 443, 1970.

Edgerton, Alvin T. *See* Hruby, Ronald J. 09095

Eggert, Donald A. *See* Millay, Michael A. 01672

01757 **Eggler, David H.** Compositions of coexisting olivines, orthopyroxenes, magnetites, and plagioclase in the system $NaAlSi_3$-$CaAl_2Si_2O_8$-SiO_2-MgO-FeO-Fe_2O_3 [abs.]: EOS, v. 51, no. 4, p. 438-439, 1970.

08954 **Egyed, L.** The slow expansion hypothesis, *in* The application of modern physics to the earth and planetary interiors (S. K. Runcorn, editor): London and New York, Wiley-Interscience, p. 65-75, illus., 1969.

Observations suggesting an expansion of the Earth amounting to an increase of 0.65 ± 0.15 mm per yr in radius are summarized. Properties characterizing continental and oceanic areas are plausible on the basis of a simple mechanism in which a primaeval uniform crust disrupted under the effect of internal expansion, permitting emergence of denser material along fracture lines which, under isostatic control, occupied a level about 5km lower than the original crust to form ocean basins. Simple model experiments are discussed to show how fracture lines similar to those along coast lines of continents can be produced and used to estimate rate of expansion. It is shown that the amount of expansion estimated can be effected only on the basis of Dirac's theory, and by assuming average radioactivity for the Earth's interior corresponding to that of basalt and existence of high-pressure phases of the type proposed by Ramsey. A step-by-step evolution of continental drift is given. — VSN

01537 **Ehrlich, Robert; Weinberg, Bernhard.** An exact method for characterization of grain shape: Jour. Sed. Petrology, v. 40, no. 1, p. 205-212, illus., table, 1970.

Grain shape may be described as precisely as needed by Fourier series expansion of the radius about the center of mass utilizing coordinates of peripheral points. Empirical results of grains from typical samples indicate that the series contains, in partitioned form, a large amount of geologically interesting information. Consequently, previous subjective evaluations of the worth of shape variations in the solution of geologic problems are justified. The shape variable is amenable to semiquantitative graphical evaluation or may be used as data for multivariate analytical schemes. Illustrative examples show that the shape variables easily discriminate grain differences arising from geographic, stratigraphic, and process factors. — Authors' abstract

01758 **Elders, Wilfred A.; Robinson, Paul T.** Possible sea-floor spreading in the Imperial Valley of California — [Pt.] 4, A model for magma generation [abs.]: EOS, v. 51, no. 4, p. 422, 1970.

Elders, Wilfred A. *See* Robinson, Paul T. 01823

Elliott, D. E. *See* Wickham, J. S. 01849

01759 **Elliott, David.** The flow of basement into nappes [abs.]: EOS, v. 51, no. 4, p. 431, 1970.

Ellis, Howard. *See* Davis, Douglas. 09053

Elrick, D. E. *See* Bachmat, Y. 01714

08962 **Elsasser, W. M.** Convection and stress propagation in the upper mantle, *in* The application of modern physics to the earth and planetary interiors (S. K. Runcorn, editor): London and New York, Wiley-Interscience, p. 223-246, illus., 1969.

The upper mantle is shallow, approximately 800 km in depth, with a preponderance of horizontal motions. This motion is mainly caused by pronounced minimum of viscosity between about 100 and 200 km depth. Mechanical arguments, given here, show that horizontal sliding of the top layer (tectosphere) is more easily achieved than circulation in material beneath. Mechanical stresses are preferentially transmitted horizontally along the tectosphere, which accounts for the correlation between ridges or upwellings in the mantle, and continental margins which are shallow features on a mantle-wide scale. It is concluded that convective circulation in the upper mantle is controlled by irregularities of the upper surface, in a manner inverse to the way in which thermal convection of a fluid is often controlled by corrugations of its lower boundary. — *from* Author's summary

01678 **Emiliani, C.** Pleistocene paleotemperatures: Science, v. 168, no. 3933, p. 822-825, illus., table, 1970.

The generalized isotopic paleotemperature curve reproduces absolute temperatures to within 1°C, it closely reflects faunal changes, and its time scale is correct to within a very few percent back to at least 175,000 years. The average oxygen isotopic com-

position of the North American and European ice caps was about -9 per mil. — Author's abstract

01530 **Emmett, L. F.; Jeffery, H. G.** Reconnaissance of the ground-water resources of the Missouri River alluvium between Miami and Kansas City, Missouri: U.S. Geol. Survey Hydrol. Inv. Atlas HA-344, scale 1:125,000, text, 1970.

The bluffs and rounded hills which border the Missouri River flood plain between Miami and Kansas City are composed of shale, limestone, and sandstone; the same types of rocks also underlie the alluvium and form the rock surface upon which alluvial sand and gravel rests. Ground water in the alluvial aquifer occurs under water-table and artesian conditions which vary geographically and in time. Combined municipal, industrial, and irrigation use of water is about 1.25 mgd. Water in alluvium is a calcium bicarbonate type, with high hardness and high iron content. Chief problems in development of wells or well fields in this aquifer are encrustation of well screens and excessive drawdowns caused by placing wells too close to each other. — MCM

01723 **Emslie, R. F.** The geology of the Michikamau Intrusion, Labrador (13L, 23I): Canada Geol. Survey Paper 68-57, 85 p., illus., geol. maps, 1970.

The intrusion underlies about 2,000 sq km in west-central Labrador, and is one of the larger anorthositic plutons in the Nain Province. The original form was a lopolith that has been modified by postconsolidation faulting. The marginal zone is chiefly olivine gabbro. The layered series is mainly troctolite and leucotroctolite overlain by a thick anorthosite zone and an upper zone of leucogabbro and gabbro. Structural interpretation is based on rhythmic layering and planar plagioclase. Layering is subparallel to the walls and probably formed through action of convection currents. The intrusion was emplaced along the contact of a granulitic gneiss basement complex and a supracrustal sequence. Magma is believed to have been an aluminous basaltic liquid carrying suspended plagioclase crystals which rose to accumulate in the upper part, and solidification took place by bottom accumulation of crystals. — *from* Author's abstract

01631 **Engdahl, Eric R.; Brockman, Stanley R.; King, Kenneth W.** MILROW seismic effects [abs.]: EOS, v. 51, no. 3, p. 204, 1970.

Epstein, Samuel. *See* Savin, Samuel M. 01732

Epstein, Samuel. *See* Suzuoki, Tetsuro. 01869

01621 **Erlank, A. J.; Kushiro, I.** Potassium contents of synthetic pyroxenes at high temperatures and pressures: Carnegie Inst. Washington Year Book 68, 1968-69, p. 439-442, table, 1970.

01690 **Erlank, A. J.** Distribution of potassium in mafic and ultramafic nodules: Carnegie Inst. Washington Year Book 68, 1968-69, p. 433-439, illus., 1970.

Ernst, W. G. *See* Brace, William F. 01409

01760 **Ernst, W. G.** Petrologic reconnaissance of Franciscan metagraywackes from the Diablo Range, California Coast Ranges [abs.]: EOS, v. 51, no. 4, p. 445, 1970.

Erskine, W. S. *See* Rozendal, R. A. 01424

01701 **Eugster, O.; Tera, F.; Burnett, D. S.; Wasserburg, G. J.** Neutron capture effects in Gd from the Norton County meteorite: Earth and Planetary Sci. Letters, v. 7, no. 5, p. 436-440, illus., table, 1970.

The isotopic composition of Gd in one chondrite, two achondrites, and the silicate inclusions of two meteorites have been determined. When corrected for mass discrimination, Gd in all samples except the Norton County achondrite shows the same relative isotopic abundances as terrestrial Gd. These results set an upper limit of 3 ×

10^{15} neutrons per cm^2 on a differential integrated thermal neutron irradiation of the earth and these meteorites. Neutron capture effects are present in Gd extracted from the Norton County achondrite. These most probably have been produced by secondary neutrons during the exceptionally long cosmic ray exposure of this large stone meteorite. The isotopic anomalies correspond to an integrated thermal neutron flux of $(6.3 \pm 0.9) \times 10^{15}$ neutrons per cm^2. — Authors' abstract

01563 **Everts, James Mitchell.** Fatty acid analysis of some fossil and recent bones and teeth [abs.]: Dissert. Abs. Internat., Sec. B, Sci. and Eng., v. 30, no. 9, p. 3970B, 1970.

Evertson, D. W. *See* Sacks, I. S. 01622

Ewing, M. *See* Kuo, J. T. 01674

Ewing, Maurice. *See* Miyashiro, Akiho. 01642

09110 **Ewing, Maurice; Worzel, J. Lamar; Burk, Creighton A.** Regional aspects of deep-water drilling in the Gulf of Mexico, east of the Bahama Platform and on the Bermuda Rise, *in* Initial reports of the Deep Sea Drilling Project — V. 1, Leg 1 of cruises of *Glomar Challenger*, Orange, Tex., to Hoboken, N. J., Aug.-Sept. 1968: Washington, D.C., U.S. Govt. Printing Office, p. 624-640, illus. [1969?].

Cores from the northern site in the Gulf show many small chevron folds. Others show that Challenger Knoll has probably existed since late Miocene, and seismic profiles suggest it is still growing. Seismic profiles in the plain have shown overlapping sequences, and cores show turbidites with different provenances diminishing through time. In core data from sites in the Blake-Bahama basin, almost all Tertiary and Cretaceous stages were identified. Seismic Horizon A lies near the Cretaceous-Tertiary boundary; Horizon B is apparently the mid-Cenomanian unconformity. At sites 6 and 7 on the southern flank of Bermuda Rise, if Horizon A is an ancient turbidite, younger arching and uplift of the Rise are required; the section consists of brown deep-sea clay overlying mid-Eocene turbidites which are underlain by deep-sea clays. Alternative theories for the origin of these sequences are given. — ESL

01555 **Fabbi, Brent P.** A die for pelletizing samples for X-ray fluorescence analysis, *in* Geological Survey research 1970, Chap. B: U.S. Geol. Survey Prof. Paper 700-B, p. B187-B189, illus., 1970.

The preparation of pellets of powdered geological samples is a critical step in X-ray fluorescence analysis. A special die has been designed to produce smooth surfaces on extremely durable pellets and to provide a protective, hard outer ring and backing. The outer ring minimizes the deterioration of the edge that has in the past limited the usable life of the pellet. Repetitive preparations have shown reproducibility and homogeneity to be within normal counting statistics. — Author's abstract

Fahlquist, Davis A. *See* Pyle, Thomas E. 09131

Faller, J. E. *See* Alley, C. O. 08908

09061 **Fang, H. Y.** Pressuremeter correlation study — Discussion [of paper by C. M. Higgins, 1969]: Highway Research Rec. 284 (Natl. Acad. Sci. Pub. 1661), p. 61-62, 1969.

Fang provides additional information to Higgins' paper (ibid., p. 51-60) both on the apparatus and test methods from a similar study developed at the AASHO Road Test. An internal-deformation device for measuring creep volume change due to lateral pressure, developed in 1956, is described. — ESL

Fawcett, J. J. *See* Grieve, Richard A. F. 01770

09068 **Feder, Gerald L.** The use of springflow-recession curves to determine the source of springflow in the Missouri Ozarks [abs.]: Natl. Speleol. Soc. Bull., v. 31, no. 2, p. 38, 1969.

Federer, B. *See* Philberth, K. 01498

09041 **Ferguson, Carl C.** Geologic map of the Henry quadrangle, Tennessee: Tennessee Div. Geology Geol. Map GM 9-NW, scale 1:24,000, separate text, 1969.

Clay suitable for ceramic use is found in the Claiborne Formation in the Henry quadrangle; sand is abundant and occurs in every formation. — MCM

09044 **Ferguson, Carl C.** Geologic map of the Sparta quadrangle, Tennessee: Tennessee Div. Geology Geol. Map GM 332-NW, scale 1:24,000, separate text, 1969.

Mined mineral resources in the Sparta quadrangle are: limestone from the St. Louis, Monteagle, and Bangor limestones; coal from the Lower Bon Air seam; and sandstone from the Hartselle Formation. Potential resources are sand, shale, and chert. — MCM

Finkelman, R. B. *See* Millard, H. T., Jr. 01441

01443 **Fireman, E. L.; Goebel, R.** Argon 37 and argon 39 in recently fallen meteorites and cosmic-ray variations: Jour. Geophys. Research, v. 75, no. 11, p. 2115-2145, illus., tables, 1970.

The 35-day Ar-37 and the 270-year Ar-39 isotopes were measured in the iron-ataxite meteorite Alandroal (which fell on November 14, 1968) and in two recently fallen stony meteorites, Allende (February 1969) and Sprucefield (April 1969). The results are discussed in terms of cosmic-ray flux variations due to orbital motions before collision with the Earth. The radioactivities and stable rare gases were also measured in the stony meteorite Ankobar, which fell in 1949. No argon radioactivities were detected in the iron ataxite Deep Springs indicating that it landed more than 2,000 years ago. — GV

09083 **Fish, John; Russell, William H.** Reconnaissance geology and genesis of the deep pits in the Aquismon karst area, San Luis Potosí, Mexico [abs.]: Speleol. Soc. Bull., v. 31, no. 2, p. 49, 1969.

01696 **Fisher, David E.** Uranium measurements in hypersthene chondrites and their relation to the 600-700 million year "event:" Earth and Planetary Sci. Letters, v. 7, no. 3, p. 278-280, table, 1970.

The results of homogenized fission track analysis of the U abundance in 19 hypersthene chondrite falls show an average of 15 ppb U in each, and an average age of 350 ± 35 m.y., in agreement with other calculations. The 600-700 m.y. ages suggested by other workers can be explained by experimental procedural differences. The loss is taken into account in these figures. Since there are four Fe events recognized in meteorites, the loss of the He-4 event would be likely to be nearly coincidental with any, so that the coincidence of finding the He and Fe events similar is not as important as it may seem. No other chondrite "event" has been found to be coincident with any of the iron "events." — HRC

01761 **Fisher, George W.** Applications of ionic equilibria to metamorphic differentiation [abs.]: EOS, v. 51, no. 4, p. 445, 1970.

Fisher, Richard V. *See* Mattinson, James M. 01552

Fitch, T. *See* Scholz, C. H. 01830

Fleischer, R. L. *See* Hart, H. R., Jr. 01778

08973 **Fleischer, R. L.; Price, P. B.; Walker, R. M.** Fission track dating and processes in the Earth's interior, *in* The application of modern physics to the earth and planetary interiors (S. K. Runcorn, editor): London and New York, Wiley-Interscience, p. 499-503, tables, 1969.

Published papers of Fleischer, Price, and Walker, and a few others, concerning fission-track dating are summarized briefly. Fission-track dating with its wide accessible time span and many temperature indicators presents multiple opportunities for studying chronology of thermal, magnetic, and mechanical processes in planetary bodies. Measurements involving thermal effects in nature have been made, but measurements for dating paleomagnetic and paleomechanical processes in the Earth have not yet been attempted. — VSN

01524 **Fleming, George.** Sediment measurement techniques — [Pt.] A, Fluvial sediment — Discussion [of paper 6756 by Am. Soc. Civil Engineers (Task Comm. on Preparation of Sedimentation Manual), 1969]: Am. Soc. Civil Engineers Proc., v. 96, Jour. Hydraulics Div., no. HY 4, p. 1075-1076, 1970.

The nuclear direct sensing device makes a significant contribution to monitoring of suspended-sediment concentration in high ranges, but is less sensitive in the range 5,000 ppm and less, which will have a significant effect on long-term suspended-sediment loads. Several instruments that cover this range have been tested. Fleming believes that bed load measurements and computation problems may best be solved by a combination of intensive measurement and development of a simulation approach (original paper, ibid., v. 95, no. HY 5, p. 1477-1514, 1969). — ESL

01609 **Fleming, George.** Sediment measurement techniques — [Pt.] F, Laboratory procedures — Discussion [of paper 6757 by Am. Soc. Civil Engineers (Task Comm. on Preparation of Sedimentation Manual), 1969]: Am. Soc. Civil Engineers Proc., v. 96, Jour. Hydraulics Div., no. HY 4, p. 1076-1079, tables, 1970.

Fleming believes that insufficient emphasis was placed (ibid., v. 95, no. HY 5, p. 1515-1543) on the errors that can result if considerable care is not exercised during the filtration procedure in determining sediment concentration in a water-sediment mixture. Tabulated results of analyses using two different types of filters show the gross variations that can occur, and emphasize the need for a standard technique acceptable from one country to another. Use of the Coulter counter particle size sensing device, omitted by the authors, is described here. — ESL

09078 **Foley, Robert.** A boreal fauna from Bat Cave, Pulaski County, Missouri [abs.]: Natl. Speleol. Soc. Bull., v. 31, no. 2, p. 44, 1969.

Follnsbee, A. *See* VonHerzen, R. P. 01496

01726 **Ford, D. C.; Fuller, P. G.; Drake, J. J.** Calcite precipitates at the soles of temperate glaciers: Nature, v. 226, no. 5244, p. 441-442, illus., table, 1970.

Extensive deposits of a calcite precipitate which show striking morphological characteristics and which undoubtedly have formed at the soles of glaciers have been found around Mt. Castleguard in Banff National Park, Canada. They are analogous to travertine crusts in limestone caverns, but show stronger orientation and other different features, and are restricted to the surfaces of limestone benches recently overrun by glaciers ("Neoglacial Advance"). The precipitate is calcite with up to 45 weight percent of dolomite and some "glacier flour." It is suggested that precipitation results from supersaturation consequent on reduction or release of hydrostatic pressure at the sole; glacier flour particles may play a critical seed part. — DBV

09082 **Ford, Derek C.** Cavern development in the southern Canadian Rockies [abs.]: Natl. Speleol. Soc. Bull., v. 31, no. 2, p. 47-48, 1969.

Foster, B. P. *See* Reitan, Paul H. 01820

08882 **Fountain, David K.** The application of geophysics to disseminated sulfide deposits in British Columbia [abs.]: Geophysics, v. 34, no. 6, p. 1015, 1969.

01445 **Francheteau, Jean; Harrison, C. G. A.; Sclater, J. G.; Richards, M. L.** Magnetization of Pacific seamounts — A preliminary polar curve for the northeastern Pacific: Jour. Geophys. Research, v. 75, no. 11, p. 2035-2061, illus., tables, 1970.

The technique of computing direction and intensity of magnetization of a uniformly magnetized seamount from its shape and associated magnetic anomaly has been applied to 45 seamounts, all available paleomagnetic results from the Pacific basin having been used to establish a preliminary polar curve relative to the northeastern Pacific. The curve is weighted in favor of the Cretaceous point at 61°N, 16°E, confirming earlier results indicating a 30° northward movement of the northeastern Pacific since Cretaceous. Other results suggest that the northwestern and northeastern Pacific have not always been connected rigidly and that Antarctica has remained stationary in latitude since Upper Cretaceous. It is suggested that the present Pacific plate is a composite of at least three distinct plates, volcanic aseismic ridges within the Pacific Ocean being the fossil boundaries of these now coalesced plates. — GV

08963 **Frank, F. C.** Diamonds and deep fluids in the upper mantle, *in* The application of modern physics to the earth and planetary interiors (S. K. Runcorn, editor): London and New York, Wiley-Interscience, p. 247-250, 1969.

A speculative picture of a sequence of events for formations of diamonds is presented. The model provides requisite conditions for diamond growth and ejection, with an initial stage of growth in magma; later stage of growth in a significantly different environment, largely melted, with much turbulence in both stages; a subsequent important temperature rise, and stage of re-solution; and a rapid passage through the final 100 km in which diamond is unstable. It does not resemble any eruptive process happening at the present but involves a pocket of hot, possibly water-rich, melt-fluids or magma, slowly rising from a depth of hundreds of km and piercing a channel through a continental crust, clearing a passage for accelerated flow of more material from below. Thermal changes depend on whether work of expansion is expended elsewhere (lifting surface of Earth) or frictionally upon the rising material itself. — VSN

08995 **Fraser, J. A.** Geology, Winter Lake, District of Mackenzie: Canada Geol. Survey Map 1219A, scale 1:253,440, text, 1969.

Oldest rocks in this Precambrian area are amphibolite and hornblende schist derived from volcanic rocks; Yellowknife Group gneissic and massive granite, granodiorite, and allied rocks; massive granite and allied rocks; and diabase intruding all other rocks. A westerly movement of glacial ice can be inferred from striated and polished bedrock and from eskers and drumlinoid ridges. Sedimentary and volcanic rocks extending from Point Lake to Snare River constitute a conformable sequence of strata which lie in a major fold plunging almost vertically and open to the north; deformation in two or more stages around different axes can be inferred. Small, rusty-weathering zones, or gossans containing pyrite, or more rarely, pyrrhotite, occur along contacts of flows with sediments or granitic rocks; few are more than 15 miles wide, but in some cases can be traced along linear belts for more than one-half mile. — MCM

01573 **Frederiksen, Norman Oliver.** Stratigraphy and palynology of the Jackson Stage (Upper Eocene) and adjacent strata of Mississippi and western Alabama [abs.]: Dissert. Abs. Internat., Sec. B, Sci. and Eng., v. 30, no. 9, p. 4207B, 1970.

01715 **Freeze, R. Allan; Banner, James.** The mechanism of natural ground-water recharge and discharge — [Pt.] 2, Laboratory column experiments and field measurements: Water Resources Research, v. 6, no. 1, p. 138-155, illus., tables, 1970.

Results from a mathematical model simulating one-dimensional, vertical, unsteady, unsaturated flow above a recharging ground-water system are successfully correlated with results from a laboratory experiment using a tensiometer-transducer system. Recharge rates are controlled by the regional ground-water flow system; water-table rises from infiltration through unsaturated zones provide the source of replenishment. On Canadian prairies only spring snowmelt and occasional heavy summer rains are effective in recharge. As Saskatchewan sites indicate, observation well hydrographs alone are not sufficient to monitor recharge phenomena; measurements of hydraulic gradient above and below water table are necessary. It is erroneous to map a sand or gravel plain as an effective recharge area without investigating the influence of unsaturated properties of the soil. — *from* Authors' abstract

French, Bevan M. *See* Bottino, Michael R. 01741

09129 **Frey, Robert W.; Howard, James D.** A profile of biogenic sedimentary structures in a Holocene barrier island-salt marsh complex, Georgia, *in* Geology of the American Mediterranean: Gulf Coast Assoc. Geol. Socs. Trans., v. 19, p. 427-444, illus., 1969.

Biogenic sedimentary structures, many characteristic of particular depositional environments, are abundant among Holocene barrier island-salt marsh habitats of coastal Georgia. Major environments represented are: beaches, salt marshes, and estuaries and tidal streams. Biogenic sedimentary structures in these environments consist of bioturbate textures and various tracks, trails, burrows, and dwelling tubes, and are produced chiefly by polychaetes, mollusks, echinoderms, decapods, amphipods, and insects. Such structures are not only diagnostic of most Holocene habitats but are also capable to being preserved in the rock record. Many have been documented in the Pleistocene of Georgia and Florida. — *from* Authors' abstract

Friedman, Gerald M. *See* McKinney, Thomas F. 01656

Friedman, Gerald M. *See* Braun, Moshe. 01660

Friedman, Irving. *See* Judy, Clark. 01717

Fullagar, Paul D. *See* Bottino, Michael R. 01741

Fuller, John. *See* Hays, James D. 01429

01762 **Fuller, M.** Eastward continuation of elements of the fracture pattern of the east Pacific [abs.]: EOS, v. 51, no. 4, p. 430, 1970.

Fuller, P. G. *See* Ford, D. C. 01726

Funkhouser, J. *See* Turekian, K. K. 01700

08867 **Furnish, W. M.** Cephalopods, Chap. 10 *in* History of the Redwall Limestone of northern Arizona: Geol. Soc. America Mem. 114, p. 453-456, illus., 1969.

Nearly half of the cephalopods in the Redwall Limestone are *Triboloceras digonum*. Most of the fauna comes from the area just north of Jerome; only one fragment of an unidentifiable ammonoid was found. Almost all are from fine-grained limestone and the fauna is not considered unusual. A few of the specimens are illustrated; all are Kinderhookian. — HRC

01652 **Gaede, Verne F.** Prado-Corona oil field: California Oil Fields — Summ. Operations 1969, v. 55, no. 1, p. 23-29, illus., tables, 1970.

Prado-Corona oil field, in the western portion of Riverside County, is comprised of two separate producing areas, Sardco and Goedhart. Sedimentary rocks range in age from upper Eocene through Holocene in the Sardco area, and from Upper Cretaceous through Holocene in the Goedhart area; structure of both areas is a faulted anticline. Producing zones are the Upper and Lower Hunter in the Soquel member of the Miocene Puente Formation; a thin shale body about 10 feet thick separates the two zones into nearly equal units. — MCM

09022 **Gajardo W., Enrique.** Sistema telemétrico para una red sísmica cuadripartita—Telemetric system for a quadripartite seismic network [Spanish and English texts], *in* Pan American symposium on the upper mantle, México, D.F., 1969—Group 5, Seismology: Geofísica Internac., v. 9, nos. 1-3, p. 3-19, illus., tables, 1969.

A microwave telemetric system to be used in a quadripartite seismological network is described. Details about instruments, circuits and methods of analysis of data that will be obtained are given. Its main use is the rapid and accurate determination of epicenters for information in emergency measures and tsunami prevention. — Author's abstract

08926 **Gambrell, S. C.; Haynes, C. D.** In-situ roof trusses vs. angle roof bolts — A photoelastic comparison [abs.]: Mining Eng., v. 21, no. 12, p. 60, 1969.

01442 **Gangi, Anthony F.** A derivation of the seismic representation theorem using seismic reciprocity: Jour. Geophys. Research, v. 75, no. 11, p. 2088-2095, illus., 1970.

The seismic representation theorem is very useful in determining seismic displacements from extended and moving sources, for boundary-value problems, and for diffraction by vanishingly thin screens. The derivations of that theorem for anisotropic and homogeneous elastic media given by Knopoff [1956] and deHoop [1958], while elegant, are difficult. The seismic representation theorem is derived here in a simple straightforward manner using the principle of seismic reciprocity as the starting point. The derivation is simplified further by the use of the polyadic notation. The representation theorem obtained is valid for anisotropic, inhomogeneous, linear elastic media. The utility of the representation theorem is demonstrated by considering illustrative examples concerning: the radiation fields from various force couples; the radiation from moving forces; and the diffraction of elastic waves by thin screens. — *from* Author's abstract

Gardner, Richard A. *See* Weigle, James M. 01607

09000 **Gardner, William I.** Dams and reservoirs in Pleistocene-eolian deposit terrain of Nebraska and Kansas, *in* Reservoir leakage and groundwater control: Assoc. Eng. Geologists Bull., v. 6, no. 1, p. 31-44, illus., table, 1969.

The water-holding capabilities of some U.S. Bureau of Reclamation storage reservoirs and dams in eolian deposit terrane are discussed. Some hydrologic characteristics of the geologic formations are considered as are some of the investigational procedures, design and construction features and postconstruction treatment to meet the hydrogeologic conditions. Seepage from the reservoirs serves to recharge groundwater and some returns to the streams; it is recoverable in part for beneficial use. Lightweight, loess soils subject to excessive settlement when wetted and loaded were successfully preconsolidated to provide adequate dam foundations. — Author's abstract

09042 **Garman, R. Keith; Russell, Ernest E.** Geologic map of the West Sandy Dike quadrangle, Tennessee: Tennessee Div. Geology Geol. Map GM 19-SW, scale 1:24,000, separate text, 1969.

The accompanying text, "Mineral resources summary of the West Sandy Dike quadrangle, Tennessee," by R. K. Garman is cited separately. — MCM

09043 **Garman, R. Keith.** Mineral resources summary of the West Sandy Dike quadrangle, Tennessee: Nashville, Tenn., Tennessee Div. Geology, 8 p., tables, 1969.

This text to accompany Tennessee Div. Geology Geol. Map GM 19-SW (R. K. Garman and E. E. Russell, cited separately) describes the clay resources in the McNairy Sand which are rarely mined today because they are generally siliceous and contain excessive iron. Potential resources are sand and heavy-mineral sand. — MCM

Garrett, R. G. *See* Boyle, R. W. 01697

01707 **Garrison, C. J.** Flow rates in two-dimensional, unsteady, confined groundwater flow — Discussion [of paper 6451 by B. W. Hunt, 1969]: Am. Soc. Civil Engineers Proc., v. 96, Jour. Hydraulics Div., no. HY 1, p. 286-288, 1970.

The author's lengthy development and arguments (ibid., v. 95, no. HY 2, p. 603-608, 1969) amount simply to the separation of variables technique. Since the technique is well known, approaching the problem from this point of view might clarify the development; certainly it is sufficient for the two types of elementary boundary conditions considered. In the so-called "extension" of the theory, it may be that the roundabout approach has obscured the simplicity of the work; therefore, a straightforward development is presented here. — ESL

09124 **Gartner, Stefan, Jr.** Correlation of Neogene planktonic foraminifer and calcareous nannofossil zones, *in* Geology of the American Mediterranean: Gulf Coast Assoc. Geol. Socs. Trans., v. 19, p. 585-599, illus., 1969.

Using overlapping segments from deep-sea cores previously dated by planktonic foraminifers, calcareous nannofossils were analyzed for the interval uppermost Miocene to Recent, to relate nannofossil ranges of established foraminiferal zones. Ten calcareous nannofossil zones are readily distinguishable for this interval: two for uppermost Miocene, five for Pliocene, and three for Quaternary-Recent. Boundaries of calcareous nannofossil zones do not correspond to those of the planktonic foraminifers, although in some cases they are relatively close. One exception is the top of zone N-21, marked by the first evolutionary occurrence of *Globorotalia truncatulinoides*, and which corresponds rather closely to extinction of discoasters. — *from* Author's abstract

Gast, Paul W. *See* Oversby, Virginia M. 01508

Gast, Paul W. *See* Kay, Robert. 01787

08883 **Gaucher, Edwin; Salamis, C.** Geophysical tests over a Turam copper discovery in Louvincourt Township [abs.]: Geophysics, v. 34, no. 6, p. 1016, 1969.

01548 **Gaudette, Henri E.; Anderson, Franz E.** Possible sources of error in particulate matter analysis using silver filters: Jour. Sed. Petrology, v. 40, no. 1, p. 462-464, illus., 1970.

A systematic weight loss has been observed during particulate matter filtration using silver filters. This loss is related to the formation of silver chloride which may lead to incorrect interpretation of X-ray diffractograms and the subsequent composition of the particulate matter. — Authors' abstract

Gebelein, Conrad D. *See* Neumann, A. Conrad. 01538

01554 **Gebelein, Conrad D.** Distribution, morphology, and accretion-rate of recent subtidal algal stromatolites, Bermuda — Reply to comment by [J. H.] Sharp [1970]: Jour. Sed. Petrology, v. 40, no. 1, p. 522, 1970.

Most of Sharp's criticisms of the original work [ibid., v. 39, p. 49-69, 1969] were in fact discussed in the original. — HRC

08978 **Gee, K. H.; Osborn, E. F.** Studies of phase equilibria in the systems CaO-MgO-Al_2O_3-SiO_2 and CaO-MgO-Al_2O_3-TiO_2SiO_2 — Pt. 2, Phase equilibria at liquidus temperatures in a part of the system CaO-MgO-Al_2O_3-SiO_2 — The system $Ca_2MgSi_4O_7$-$Ca_2Al_2SiO_7$-$CaMgSi_2O_6$-$CaAl_2Si_2O_8$: Pennsylvania State Univ. Coll. Earth and Mineral Sci. Expt. Sta. Bull. 85, p. 23-51, illus., tables, 1969.

Quenching data for 102 mixtures are presented for the above systems (akermanite-gehlenite-anorthite-diopside). Diagrams are presented to show: limiting systems, compositions of mixtures and liquidus surface, three-phase boundaries and conjugation lines, and paths of crystallization for conditions of perfect fractionation and equilibrium. X-ray diffraction techniques were used to determine solid solution compositions, and the 2θ angles for the 211 reflections with filtered Cu Kα radiation are presented for the akermanite-gehlenite series of solid solutions. — *from* Authors' abstract

Gelpi, E. *See* Schneider, H. 01635

01683 **Gelpi, E.; Schneider, H.; Mann, J.; Oró, J.** Hydrocarbons of geochemical significance in microscopic algae: Phytochemistry, v. 9, no. 3, p. 603-612, illus., tables, 1970.

Recent investigations have implicated correlation between hydrocarbons in algae and in ancient sediments. Data are presented on hydrocarbon production by 12 living species morphologically similar to Precambrian and Tertiary forms, of the genera

Anacystis, *Spirulina*, *Lyngbya*, *Nostoc* (blue-green); *Coelastrum*, *Chlorella*, *Scenodesmus*, *Tetraedron* (green); and *Botryococcus* (golden-brown). Normal hydrocarbon range is from C15 to C19 in most species, but a few show a bimodal distribution of aliphatic hydrocarbons with maxima at C17 and C27. Similar bimodal distributions of saturated hydrocarbons have been observed in both Precambrian and Tertiary sediments. Methyl-substituted alkanes, also found in Precambrian sediments, are produced by blue-green algae. Squalene and a triterpene were identified in algae; their saturated counterparts are found in sediments and petroleum. — VMJ

09088 **Geological Society of America.** (North-Central Section). Field trip guidebook, 3d annual meeting, 1969: Columbus, Ohio, Ohio Div. Geol. Survey, [76] p., illus., 1969.

This volume contains four reports (separately cited) on field trips in the central part of Ohio, covering Devonian outcrops, till stratigraphy and Ordovician conodont localities in the Columbus area and southwest of the city, and Mississippian strata in the Granville-Newark area. The papers were given at the third annual meeting of the North-Central Section of the Geological Society of America at Columbus, May 15-17, 1969. — EH

Ghose, Subrata. *See* Saxena, Surendra K. 01828

Giard, W. R. *See* Hart, H. R., Jr. 01778

01763 **Giardini, A. A.; Abey, A. E.; Liptai, R. G.** The shear strength of 3 Georgia marbles and Solenhofen Limestone to 70 kilobars [abs.]: EOS, v. 51, no. 4, p. 424, 1970.

Gieskes, J. M. T. M. *See* Mangelsdorf, P. C., Jr. 01419

01720 **Gilbert, C. R.** Water-loss studies of Lake Corpus Christi, Nueces River basin, Texas, 1949-65: Texas Water Devel. Board Rept. 104, 11 p., illus., table, 1970.

Accuracy of records showing large surface-water losses after enlargement of Lake Corpus Christi reservoir was suspect because of underestimation of permeability of underlying sediments. Initial inflow to the enlarged reservoir raised lake level 16 feet and increased the inundated area by 30 sq mi. Except for the original 32,000 acre-feet loss to alluvium, all unaccounted surface-water loss from 1958 to 1965 is estimated as percolation into the Goliad Sand. Four wells in this aquifer, at different distances from the new shoreline, show average water-level rise of 17 feet for 1958-61; ground-water recharge of 342,000 acre-feet to both alluvium and Goliad Sand compares well with computed surface-loss of 360,000 for this same period. Some gain occurred with lake-level recession in 1962, and more losses with subsequent large inflows. — GDC

Gilbert, F. *See* Backus, G. 01730

01430 **Gill, J. R.; Merewether, E. A.; Cobban, W. A.** Stratigraphy and nomenclature of some Upper Cretaceous and lower Tertiary rocks in south-central Wyoming: U.S. Geol. Survey Prof. Paper 667, 50 p., illus., table, 1970.

Upper Cretaceous rocks described in this report are the Steele Shale, Mesaverde Group, Lewis Shale, and Fox Hills, Medicine Bow, and the lower part of the Ferris Formations. The Mesaverde Group, in the Rawlins-Medicine Bow area, consists of the following formations, from oldest to youngest: Haystack Mountains (new name), Allen Ridge, Pine Ridge, and Almond Formations. In the Laramie Basin the Mesaverde Group consists of the Rock River Formation (new name) and overlying Pine Ridge Sandstone. The Rock River Formation of marine origin intertongues westward with the nonmarine Allen Ridge Formation. The lower Tertiary rocks described are the upper part of the Ferris Formation of Paleocene age and the overlying Hanna Formation of late Paleocene and Eocene age. — EAM

Girard Navarrete, R. *See* Sansores Manzanilla, E. 09112

01764 **Godchaux, M. M.; Orville, P. M.** Microcline- and orthoclase-bearing pegmatites, southeastern Connecticut [abs.]: EOS, v. 51, no. 4, p. 446, 1970.

Goebel, R. *See* Fireman, E. L. 01443

08932 **Goforth, Thomas M.; Snipes, David S.** On the origin of epidote in the Fairplay quadrangle, Oconee County, South Carolina [abs.]: South Carolina Acad. Sci. Bull., v. 31, p. 55, 1969.

09090 **Goldthwait, Richard P.** Till stratigraphy from Columbus southwest to Highland County, Ohio, Field Trip 2 *in* Geol. Soc. America, North-Central Sec., 3d Ann. Mtg. 1969, Field Trip Guidebook: Columbus, Ohio, Ohio Div. Geol. Survey, p. 2-1 — 2-17, illus., 1969.

This detailed itinerary of a field trip southwest of Columbus describes glacial features and the stratigraphy of tills in four counties. Stratigraphic evidence is included for at least five separate extensions of Scioto Lobe glacier ice, separated by increasingly shorter time intervals, in the complex glacial border region from Warren and Greene Counties through Clinton and Highland Counties to Ross County. A table shows stages and substages of glacial advances, retreats and interglacials, from before about 11,000 yr B.P. to possibly 15,300 yr B.P. — EH

Goll, Robert. *See* Hays, James D. 01429

01765 **Goodacre, A. K.** Structure and composition of the deep crust and upper mantle in Canada [abs.]: EOS, v. 51, no. 4, p. 422, 1970.

01644 **Gordon, Donald C., Jr.** Microscopic study of organic particles in the North Atlantic Ocean: Deep-Sea Research, v. 17, no. 1, p. 175-185, illus., tables, 1970.

Organic particles greater than 5 μ from 38 North Atlantic stations were examined using phase microscopy. Four morphological categories were evident: aggregates, flakes, fragments and unclassifiable particles. Judging from their reactions to histochemical stains, aggregates appear to be chiefly carbohydrate, flakes chiefly protein, and fragments completely carbohydrate. Total particle concentrations ranged from 32-253/ml in surface water and 12-27/ml in deep water. Abundance of aggregates was greatest in surface waters while that of flakes and fragments was generally constant with depth. Size-frequency measurements were made, and the suitability of particles as a food source and the factors affecting their distribution are discussed. — Author's abstract

Gordon, L. I. *See* Williams, P. M. 01685

Gostintsev, K. K. *See* Nalivkin, V. D. 08951

01637 **Gotlà, Peter.** The magnetometer in oceanology: Oceanology Internat., v. 5, no. 2, p. 36-39, illus., table, 1970.

A brief description of the properties of fluxgate, optically pumped, and proton magnetometers is given, and operational requirements for gathering meaningful data are summarized. The proton magnetometer is the most widely used in oceanography, mostly for large-scale surveys of the Earth's magnetic field; these surveys have provided information on geologic structure of the ocean floor and have been important in validating theories of sea-floor spreading and continental drift. The second most important use is in offshore oil exploration. Surveys intended to gather geomagnetic data without seismic or gravity information are more cheaply done by airborne methods using a proton or cesium magnetometer or a cesium gradiometer. Magnetometers also are used offshore in exploration for minerals and for sunken ships and artifacts. — VSN

Gottfried, David. *See* Tilling, Robert I. 01411

Gough, D. I. *See* Porath, H. 01680

Gough, D. I. *See* Reitzel, J. S. 01856

09018 **Gough, D. I.; Reitzel, J. S.** Magnetic deep sounding and local conductivity anomalies, *in* The application of modern physics to the earth and planetary interiors (S. K. Runcorn, editor): London and New York, Wiley-Interscience, p. 139-153, illus., 1969.

Remarkable differences between time-varying magnetic fields recorded at stations a few tens of km apart arise from currents induced in local regions of enhanced conductivity at depths less than 700 km; these are probably regions of anomalously high temperature in the upper mantle. Delineation and study of such regions by simultaneous recording of three components of magnetic variations on a line or array of stations is called *magnetic deep sounding*. Real advances may be made in making valid separation of the internal and external fields if variation fields can be recorded simultaneously at 15 or 20 stations. A three-component recording variometer designed for this purpose is described and illustrated. A field test with eight of these variometers was carried out along the Arkansas and Gunnison Rivers in Colorado to locate the northward continuation of an anomaly in southern New Mexico. Techniques and interpretation are discussed. — VSN

09027 **Gradusov, B. P.; Stepanov, I. S.** O mineralogicheskom i khimicheskom sostave ilistykh fraktsii tropicheskikh pochv vostochnoy Kuby [Mineralogical and chemical composition of the clay fractions of the tropical soils of Eastern Cuba]: Pochvovedeniya 1969, no. 3, p. 118-129, 1969; English translation, Soviet Soil Sci. 1969, no. 3, p. 331-341, 1969.

Kaolinization, produced by recent soil development in eastern Cuba, is apparent in soils developed on the eluvium of granodiorites and andesite-basalts. In soil formed on serpentinite the increase in sesquioxide minerals content and the new formation of saponite is observed. Montmorillonite, inherited from the rock, predominates in the clay fraction of the hydromorphic soils investigated. — *from* Author's abstract

09092 **Graham, Charles E.** Mississippian strata of the Granville-Newark area, Ohio, Field Trip 4 *in* Geol. Soc. America, North-Central Sec., 3d Ann. Mtg. 1969, Field Trip Guidebook: Columbus, Ohio, Ohio Div. Geol. Survey, p. 4-1 — 4-22, illus., 1969.

The Granville-Newark area is underlain by Mississippian clastics and just to the east of Newark the Pennsylvanian sequence of clastics, coal and some limestones. A generalized section of Mississippian and Pennsylvanian strata of central Ohio is given. The Cuyahoga Formation, mostly clays and silts in the western part of the trip area, coarsens to the east where pebble conglomerates are significant lithologic elements of the Black Hand Member. The field trip includes a detailed study of the Black Hand Member as well as visits to outcrops of the Logan Formation. — EH

Granger, H. C. *See* Jacobs, M. L. 01483

01766 **Grant, James A.; Weiblen, P. W.** Retrograde zoning in garnet near the second sillimanite isograd [abs.]: EOS, v. 51, no. 4, p. 444-445, 1970.

01517 **Grass, Anthony J.** Initial instability of fine bed sand: Am. Soc. Civil Engineers Proc., v. 96, paper 7139, Jour. Hydraulics Div., no. HY 3, p. 619-632, illus., tables, 1970.

Initial entrainment characteristics of fine bed sand are objectively defined in terms of measured distributions of critical instantaneous bed shear stress associated with observed movement of individual surface grains. Critical flow conditions are then predicted by equating lower extremes in these characteristic critical shear stress distributions to upper extremes in distribution of instantaneous bed shear stress produced by the particular type of background flow under consideration. The method is applied to the case of two-dimensional channel flow over a flat bed and yields sufficiently consistent results to suggest an extension to Shields' curve for small-grain Reynolds numbers. Detailed experimental observations clearly illustrate the important role played by bed region turbulence in the interaction process between the fluid and the mobile bed grains constituting the deformable boundary. — *from* ASCE abstract

Gray, N. H. *See* Marchand, M. 01796

Green, D. H. *See* Marchand, M. 01796

01767 **Green, David H.** Petrogenetic grid for mantle-derived magmas [abs.]: EOS, v. 51, no. 4, p. 448, 1970.

01768 **Green, E. Jewett.** Predictive thermodynamic models for mineral systems [abs.]: EOS, v. 51, no. 4, p. 438, 1970.

Green, Sidney J. *See* Gregson, Victor G., Jr. 01769

01544 **Greene, H. Gary.** Microrelief of an arctic beach: Jour. Sed. Petrology, v. 40, no. 1, p. 419-427, illus., 1970.

Microrelief features develop in the spring and early summer as a result of dynamic processes associated with the breaking up of the sea ice and thawing of the kaimoo, permafrost, snowbanks, and blocks of ice stranded on the beach. The resulting microrelief forms in two zonal areas on the beach and is defined by the originating mechanisms of the microrelief features. The lower zone is restricted to the swash zone, where interaction of wave deposition and melting of stranded gravel- and sand-rich brash ice and kaimoo ice produces ice-push ridges of kaimoo ridge, sea-ice kettles and sea-ice sand and gravel cones. The upper zone is restricted to the upper foreshore and backshore, where fluvial processes form microfluvial features consisting of micro-outwash deposits and microdeltaic deposits. — *from* Author's abstract

01769 **Gregson, Victor G., Jr.; Isbell, William M.; Green, Sidney J.** Yield of Westerly Granite under shock loading [abs.]: EOS, v. 51, no. 4, p. 423, 1970.

01770 **Grieve, Richard A. F.; Fawcett, J. J.** Stability of chloritoid below 10 kb P_{H_2O} [abs.]: EOS, v. 51, no. 4, p. 437, 1970.

01499 **Griggs, G. B.; Kulm, L. D.** Sedimentation in Cascadia Deep-Sea Channel: Geol. Soc. America Bull., v. 81, no. 5, p. 1361-1384, illus., tables, 1970.

Cascadia Channel is the most extensive deep-sea channel known in the Pacific Ocean and extends across Cascadia Basin, through Blanco Fracture Zone, and onto Tufts Abyssal Plain. The channel is believed to be more than 2200 km in length and has a gradually decreasing gradient averaging 1:1000. Maximum channel relief reaches 300 m on the abyssal plain and 1100 m in the mountains of the fracture zone. The right (north and west) bank is consistently about 30 m higher than the left (south and east). Turbidity currents have deposited thick, olive-green silt sequences throughout upper and lower Cascadia Channel during Holocene time. The sediment is derived primarily from the Columbia River and is transported to the channel through Willapa Canyon. The Holocene turbidity current deposits are graded texturally and compositionally, and contain Foraminifera from neritic, bathyal, and abyssal depths which have been size-sorted. Pleistocene turbidity currents were more extensive areally than the Holocene flows. — *from* Author's abstract

Grossgeym, V. A. *See* Nalivkin, V. D. 08951

08879 **Grossling, Bernardo F.** Some color mimicry experiments in geology and geophysics [abs.]: Geophysics, v. 34, no. 6, p. 1010, 1969.

01487 **Grossman, I. G.** Waterborne styrene in a crystalline bedrock aquifer in the Gales Ferry area, Ledyard, southeastern Connecticut, *in* Geological Survey research 1970, Chap. B: U.S. Geol. Survey Prof. Paper 700-B, p. B203-B209, illus., table, 1970.

Styrene, a synthetic hydrocarbon which is only slightly soluble in water, was readily waterborne in the Gales Ferry area, Connecticut in 1961-64. Following shallow burial in 1960, styrene moved downward with vadose water through thin glacial till into the bedrock aquifer, which consists in large part of schist and quartzite of the Plainfield Formation of Cambrian(?) age and in small part of granite gneiss of the Sterling Plutonic Group of Mississippian(?) or older age. Movement from two contaminating

sources to cones of depression at six domestic wells was principally westward and northward along foliation joints and cross joints. Maximum overall movement exceeded 300 feet. Removal of the sources of contamination produced water of satisfactory chemical quality in 2 years or less. — Author's abstract

01462 **Gulbrandsen, R. A.** Relation of carbon dioxide content of apatite of the Phosphoria Formation to regional facies, *in* Geological Survey research 1970, Chap. B: U.S. Geol. Survey Prof. Paper 700-B, p. B9-B13, illus., tables, 1970.

Many recent data provide a well-defined empirical relation between the carbonate content and the *a*-cell dimension of carbonate fluorapatite, the marine variety of apatite. This relationship is used as the basis of an X-ray peak-pair method for estimating the CO_2 content of apatite. An estimate of the average CO_2 content of apatite in the Permian Phosphoria Formation, as determined on a representative group of samples by the peak-pair method, is 1.8 weight percent. Averages for a series of sections located across major rock facies from south-central Idaho to central Wyoming indicate an eastward increase in the CO_2 content of apatite that possibly was due to an increase of water temperature. — Author's abstract

01412 **Gunn, Bernard M.; Watkins, Norman D.** Geochemistry of the Steens Mountain basalts, Oregon: Geol. Soc. America Bull., v. 81, no. 5, p. 1497-1515, illus., tables, 1970.

Sixty-three samples collected from a section of 71 flows in the Steens Mountain scarp were analyzed chemically and examined petrographically for mineralogy, texture and oxidation ratios. The section was extruded 15.1 ± 0.3 m.y. ago during a period when the geomagnetic field was changing from reversed to normal polarity. Plotted chronologically the analyses have been divided into 8 groups largely on the basis of Al/K ratios. The authors report two geochemical trends, one dominated by plagioclase fractionation and the other by olivine fractionation. The samples, 15 cm cores, collected from no consistent position within the flows, were admittedly biased for paleomagnetic measurements as coarsely porphyritic and plagioclase rich segments were avoided. — RGY

09094 **Gurk, H. M.; Smith, C. R.; Wood, P.** Data handling for earth resources satellite data, *in* Symposium on remote sensing of environment, 6th Internat., Ann Arbor, Mich., 1969, Proc., V. 1: Ann Arbor, Mich., Univ. Michigan, Willow Run Labs., p. 247-259, illus., 1969.

The paper gives results of an RCA study for the U.S. Geological Survey on setting up a data center for initial processing, quick reaction analysis, classification and indexing, storage and retrieval, reproduction and dissemination of data from Earth resources satellites. Both video and digital data will be recorded on magnetic tape as input to the center. Output will be magnetic tapes or reproductions such as color composites or black and white spectral separations in transparency or print form. A research group will be formed to improve techniques and facilities, to recommend applications, and to assist users. Necessary facilities and manpower are described. — EH

Gutschick, Raymond C. *See* McKee, Edwin D. 08859

Gutschick, Raymond C. *See* McKee, Edwin D. 08860

Gutschick, Raymond C. *See* McKee, Edwin D. 08861

Gutschick, Raymond C. *See* McKee, Edwin D. 08862

Gutschick, Raymond C. *See* McKee, Edwin D. 08863

Gutschick, Raymond C. *See* McKee, Edwin D. 08866

Gutschick, Raymond C. *See* McKee, Edwin D. 08870

Gutschick, Raymond C. *See* McKee, Edwin D. 08871

Gutschick, Raymond C. *See* McKee, Edwin D. 08872

01527 **Guy, Harold P.** Sediment measurement techniques — [Pt.] A, Fluvial sediment — Discussion [of paper 6756, by Am. Soc. Civil Engineers (Task Comm. on Preparation of Sedimentation Manual), 1969]: Am. Soc. Civil Engineers Proc., v. 96, Jour. Hydraulics Div., no. HY 5, p. 1212-1215, illus., 1970.

This report (ibid., v. 95, no. HY 4, p. 1477-1514) should help to standardize methods where new sediment-measurement programs are being implemented. Guy has prepared an alinement graph that will give round-trip transit rate as well as the sampling time for the 1/8-in, 3/16-in, and 1/4-in intake nozzles, given the sampling depth and mean velocity of flow. Additional explanation and qualifications with respect to transit rate for suspended-sediment sampling are given. Guy elaborates further on the equal-transit-rate method of obtaining representative samples, and makes some comments about quality control in sampling. — ESL

01711 **Guymon, Gary L.** A finite element solution of the one-dimensional diffusion-convection equation: Water Resources Research, v. 6, no. 1, p. 204-210, table, 1970.

The one-dimensional diffusion-convection equation has been widely used to describe approximately the transient motion of a subset of particles in river flow or porous media flow. An equivalent variational principle to the governing partial differential equations of motion is given, and a finite element solution is developed requiring only approximations in the space domain. The solution is applicable to a wide variety of field problems because it can account for a variety of boundary conditions. Additionally, the solution is not dependent upon constant parameters of motion over the entire domain of interest. — Author's abstract

01771 **Haas, Herbert; Holdaway, M. J.** Stability relations of corundum and diaspore in the medium pressure and temperature range [abs.]: EOS, v. 51, no. 4, p. 437, 1970.

01871 **Haas, John L., Jr.** The effect of salinity on the maximum thermal gradient of a hydrothermal system at hydrostatic pressure and near boiling [abs.]: EOS, v. 51, no. 4, p. 453, 1970.

01460 **Hach-Ali, P. Fenoll; Ottemann, J.** Linneit und Bravoit von Fredericktown, Missouri (eine Mikrosonde-Untersuchung): Aufschluss, v. 21, no. 1, p. 29-33, illus., tables, 1970.

The sulfide minerals in strata-bound polymetallic deposits of Fredericktown, Mo., here listed with their formulas, show such strong variation in composition and growth relations that it may be possible to use them as geologic thermometers. Rarely are any minerals so pure. Of the two selected for electron probe analysis, bravoite generally occurs in the transition zone with pyrite and other sulfides or disseminated in graywacke, constituting about 2-10 percent of the sulfides. Under probe it showed abrupt irregular zonation, particularly sharp in small grains, more gradual in the larger, and progressively iron-poor to iron-rich from inside outward. Linnaeite, mostly idiomorphic in unbroken grains and sometimes strongly cataclastic, had a relatively narrow field of variation. The range of variation set forth here is a necessary part in crystal chemical interpretation of hydrothermal epigenesis. — GDC

01772 **Hafner, S. S.; Weber, H. P.; Kullerud, Gunnar.** Vacancy distribution in kenotetrahedral magnetite [abs.]: EOS, v. 51, no. 4, p. 447, 1970.

Haggerty, S. E. *See* Lindsley, D. H. 01795

01709 **Hagist, Warren M.; Huff, Lewis L.** Dispersion of silt particles in open channel flow — Discussion [of paper 6579 by W. W. Sayre, 1969]: Am. Soc. Civil Engineers Proc., v. 96, Jour. Hydraulics Div., no. HY 1, p. 299-302, illus., 1970.

In his discussion of the dispersion of fluorescent dye (ibid., v. 95, no. HY 3, p. 1009-1038, 1969) Sayre used the Pearson Type III distribution function to compare numerical solutions of moment equations. Hagist and Huff examine in more detail the fitting of a Pearson Type distribution, using moments calculated by the Aris moment

method. Results show that the distribution function is a bell-shaped Pearson Type I. They have extended the Sayres' work by computing the fourth moment of distribution, and as a result two equations for the flatness factor may be added to Table 1. — ESL

01665 **Hahn, Hermann H.; Stumm, Werner.** The role of coagulation in natural waters: Am. Jour. Sci., v. 268, no. 4, p. 354-368, illus., tables, 1970.

The rate of coagulation of montmorillonite, kaolinite, illite, and silica was determined on the basis of theoretical calculations and experimental measurements in solutions of specified conditions of pH, ionic strength, or individual concentration of ions. The size of the colloidal aggregates formed in a natural water within a certain time of reaction is calculated from these rates of coagulation. From this, the effects of aggregation, sedimentation, and horizontal transport of colloids in natural water are discussed: the changes in the concentration and composition of the dispersed phase and the horizontal and vertical change in the pattern of sedimentation. The developed models are first assumptions only, but they show that it is useful to apply principles of colloid chemistry in describing composition of natural waters and underlying sediments. — *from* Authors' abstract

01773 **Hall, W. Roger; Randall, Walter; Rex, Robert W.** Possible sea-floor spreading in the Imperial Valley of California — [Pt.] 2, Configuration of the basement [abs.]: EOS, v. 51, no. 4, p. 421-422, 1970.

Haines, E. L. *See* Hart, H. R., Jr. 01778

01774 **Halbig, J. B.** The crystalline solubility of thallium in synthetic sphalerite and galena — An interpretation of some natural occurrences of the element [abs.]: EOS, v. 51, no. 4, p. 453, 1970.

01574 **Hall, Frank Washington.** Bedrock geology, north half of Missoula 30' quadrangle, Montana [abs.]: Dissert. Abs. Internat., Sec. B, Sci. and Eng., v. 30, no. 9, p. 4208B, 1970.

09066 **Halliday, William R.** Oregon Cave, Klamath Mountains, Oregon: Natl. Speleol. Soc. Bull., v. 31, no. 2, p. 23-31, illus., 1969.

Oregon Cave is a large, strike-oriented cavern in marble parallel to a mountainside, with unusual features suggesting that its upper, southern end has served as a collecting area for storm water access to the shallow phreatic zone in which most of the rest of the cave developed. With about 1 1/2 miles explored and mapped, it is by far the longest limestone cave known in the northwestern United States. — Author's abstract

Halpin, D. *See* Vozoff, K. 08877

01628 **Hamilton, R. M.; Healy, J. H.** Aftershocks of the JORUM underground nuclear explosion [abs.]: EOS, v. 51, no. 3, p. 203, 1970.

Hanna, F. K. *See* High, C. 08902

01559 **Hanna, W. F.** Aeromagnetic and gravity features of the western Franciscan and Salinian basement terranes between Cape San Martin and San Luis Obispo, California, *in* Geological Survey research 1970, Chap. B: U.S. Geol. Survey Prof. Paper 700-B, p. B66-B77, illus., 1970.

Aeromagnetic and gravity data covering a 30- by 65-mile area along the southwest coast of California help delineate the occurrence of subsurface serpentinites, plutonic and metamorphic rocks, and sedimentary basin fill within the eugeosynclinal Franciscan and the plutonic and metamorphic Salinian basement complexes. The magnetic data suggest that the buried contact between basement tracts forms a broad arc, convex toward the northeast, between the exposed basement contacts in the northern and southern parts of the area. Gravity data conspicuously reflect thick

sedimentary rock accumulations within each of the basement terranes. — Author's abstract

01775 **Hanson, Gilbert N.** Rate of loss of radiogenic argon from biotite in whole rock laboratory heating [abs.]: EOS, v. 51, no. 4, p. 433, 1970.

01693 **Harada, Kaoru.** Origin and development of optical activity of organic compounds on the primordial Earth: Naturwissenschaften, v. 57, no. 3, p. 114-119, illus., tables, 1970.

The origin of optical activity is defined as the appearance of some amount of optically active organic compounds on some limited area on the primitive Earth. It might not be a single process; several individual or cooperative processes could constitute the origin. Some experimental results which may be related to the origins of optical activity are presented. — DBV

01590 **Harbaugh, John W.** Computer simulation of marine sedimentation [abs.]: Am. Assoc. Petroleum Geologists Bull., v. 54, no. 3, p. 555, 1970.

Harbour, Robert L. *See* Bachman, George O. 01612

08910 **Hardin-Simmons Univ. Geology Club.** Environmental studies on the geology of west central Texas — Field guide book to the geology of the Pennsylvanian-Permian-Quaternary sequences of central West Texas (Southwestern Assoc. Student Geol. Socs., 9th Ann. Field Trip): Abilene, Tex., Hardin-Simmons Univ. Geology Club, 48 p., illus., 1969.

This field trip deals with the geologic section from the Cisco-Breckinridge area through Abilene to the Sweetwater area, with emphasis on depositional environments. During the first day, between Cisco and Abilene, attention is on the Pennsylvanian and Permian periods, and the second day, between Abilene and Sweetwater, on the Permian and Quaternary periods. Different members of the Guidebook Committee review regional structure and physiography, environment of deposition, and subaerial channel deposits; list fauna of the Graham, Pueblo, and Moran Formations; and describe features at the stops. Short contributions on White Flat oil field, by Clark Orr, and on a bored crinoid, by Nita Fleming are cited separately. — GDC

01776 **Hargraves, R. B.** Progressive experimental oxidation of titaniferous magnetite and attendant change in magnetic properties [abs.]: EOS, v. 51, no. 4, p. 436, 1970.

Harrison, C. G. A. *See* Francheteau, Jean. 01445

Harrison, W. *See* Lynch, M. P. 01546

01777 **Harrison, W. D.; Kamb, Barclay.** Direct measurement of sliding velocity at the base of a glacier [abs.]: EOS, v. 51, no. 4, p. 431, 1970.

Hart, David N. *See* Norris, Roger A. 01438

01778 **Hart, H. R., Jr.; Haines, E. L.; Fleischer, R. L.; Giard, W. R.** Fission track ages and uranium contents of glasses [abs.]: EOS, v. 51, no. 4, p. 450, 1970.

01613 **Hart, S. R.** Sea floor basalts: Carnegie Inst. Washington Year Book 68, 1968-69, p. 403-408, illus., 1970.

Hart, S. R. *See* Krogh, T. E. 01614

Hart, S. R. *See* Brooks, C. 01615

Hart, S. R. *See* Brooks, C. 01616

Hart, S. R. *See* Brooks, C. 01617

Hart, S. R. *See* Brooks, C. 01618

01619 **Hart, S. R.; Brooks, C.** Rb-Sr mantle evolution models: Carnegie Inst. Washington Year Book 68, 1968-69, p. 426-429, illus., table, 1970.

01620 **Hart, S. R.; Davis, G. L.; Brooks, C.; Krogh, T. E.** The K, Rb, Cs, and Sr geochemistry of Archaean metavolcanics: Carnegie Inst. Washington Year Book 68, 1968-69, p. 429-433, illus., tables, 1970.

Hasan, Zia-Ul. *See* Wynne-Edwards, H. R. 01668

08930 **Haselton, George M.** Recent history of glaciation in northeastern Baffin Island, Canada [abs.]: South Carolina Acad. Sci. Bull., v. 31, p. 54, 1969.

Haskin, L. A. *See* Cullers, R. L. 01754

08931 **Hatcher, R. D., Jr.** Complex history of some metasediments in northwest South Carolina [abs.]: South Carolina Acad. Sci. Bull., v. 31, p. 54-55, 1969.

Haushild, W. L. *See* Nelson, Jack L. 01716

Hay, William W. *See* Čepek, Pavel. 09122

Haynes, C. D. *See* Gambrell, S. C. 08926

01429 **Hays, James D.; Cook, Harry; Cook, Frances; Fuller, John; Jenkins, Graham; Goll, Robert; Milo, Dean; Orr, William.** Deep Sea Drilling Project — Leg 9: Geotimes, v. 15, no. 4, p. 10-13, illus., 1970.

In the cruise of *Glomar Challenger* across the Pacific Ocean, from Tahiti to Panama, 9 sites and 17 holes were drilled recovering 5,045 feet of sediment. Basalt was recovered at 8 sites, signs of baking in overlying sediment indicating sills. Basal sediment ages decreasing toward the ridge crest suggest increasing spreading rates from late Eocene to middle Miocene, then a drop in rate to the present. Nearer Panama are sediment types similar to those more westerly, but higher sedimentation rates; volcanic ash layers are in upper part of the last site, where younger sediment overlying basalt suggests volcanism other than that associated with the East Pacific Rise. Age of basal sediment at next to last site suggests spreading rates similar to those west of the ridge crest during the last 10 m.y. The primary Pacific plate moved at speeds increasing from 8 to 13.3 cm per yr nearly due west until middle Miocene, then gained a northward component and decreased rate by about half. — GDC

Healy, J. H. *See* Hamilton, R. M. 01628

01779 **Heard, Hugh C.** The flow law for polycrystalline halite [abs.]: EOS, v. 51, no. 4, p. 424, 1970.

01469 **Hedge, C. E.** Whole-rock Rb-Sr age of the Pikes Peak batholith, Colorado, *in* Geological Survey research 1970, Chap. B: U.S. Geol. Survey Prof. Paper 700-B, p. B86-B89, illus., tables, 1970.

Ten whole-rock samples from the Pikes Peak batholith and 3 from the satellite Rosalie lobe yield a Rb-Sr age for the time of batholith emplacement of 1,041 ± 13 million years. All the major lithological variants were probably intruded within less than 20 m.y. The Pikes Peak batholith represents the youngest major Precambrian granitic intrusion in the Front Range. — Author's abstract

09067 **Hedges, James A.** Expanded joints and other periglacial phenomena along the Niagara escarpment [abs.]: Natl. Speleol. Soc. Bull., v. 31, no. 2, p. 37, 1969.

08942 **Helgeson, Harold C.; Brown, Thomas H.; Leeper, Robert H.** Handbook of theoretical activity diagrams depicting chemical equilibria in geologic systems involving an aqueous phase at one atm and 0° to 300°C: San Francisco, Calif., Freeman, Cooper and Co., 253 p. (incl. 227 p. diagrams), illus., 1969.

This book presents activity diagrams of chemical equilibrium among minerals and aqueous solutions for a variety of geologic systems at one or more of the following temperatures: 0°, 25°, 60°, 150°, 250°, and 300°C. Brief discussion is given of some fundamental relations and it is emphasized that activity diagrams are only as accurate as the thermodynamic data used in their construction. An index of diagrams with systems arranged alphabetically after HCl-H_2O is included. — VSN

01780 **Helz, G. R.; Barnes, H. L.** Hydrothermal solubility of magnetite [abs.]: EOS, v. 51, no. 4, p. 436, 1970.

09012 **Hemphill, William R.; Stoertz, George E.; Markle, David A.** Remote sensing of luminescent materials, *in* Symposium on remote sensing of environment, 6th Internat., Ann Arbor, Mich., 1969, Proc., V. 1: Ann Arbor, Mich., Univ. Michigan, Willow Run Labs., p. 565-585, illus., 1969.

The Fraunhofer line-depth method uses the sun as an excitation source, permits detection of luminescing materials during daylight, and has distinguished material as distant as the lunar surface. The method involves comparing a selected Fraunhofer line in the solar spectrum with the same line in a spectrum reflected from a material which may luminesce. Luminescence is indicated where the ratio of central intensity of the line to the adjacent continuum in the reflected spectrum exceeds its solar conjugate. A prototype Fraunhofer line-discriminator, suitable for aircraft operation, has been used for tests on Rhodamine WT, a luminescent dye used as a tracer in studies of current dynamics in rivers and estuaries. Test results show the instrument responds to dye concentrations as small as 1 ppb and suggest that it may be useful in time-of-travel and dispersion studies, and, if modified, to detect natural luminescence of oil seeps and spills, some water and air pollutants, and other materials. — *from* Author's abstract

Henniger, B. R. *See* Overbey, W. K., Jr. 01549

01713 **Herrera, Ismael.** Theory of multiple leaky aquifers: Water Resources Research, v. 6, no. 1, p. 185-193, illus., 1970.

This paper is an extension of previous work by Herrera and Figueroa [1969] to multiple leaky aquifers. The equations governing the motion of such systems are transformed to obtain a simpler system suitable for a numerical treatment. An essential feature of the method is the introduction of a lag time that occurs because the influence of any aquifer is not transmitted instantly to its neighbors. This approximation is suitable for treating cases for which the conditions on the aquifers vary slowly. The numerical treatment of the resulting system of equations is of the same order of complexity as that for a single aquifer. — Author's abstract

01731 **Heye, Dietrich.** A system for detection of ionium, thorium and protactinium to date deep-sea cores: Geochim. et Cosmochim. Acta, v. 34, no. 3, p. 389-397, illus., tables, 1970.

A highly sensitive system for detection of small quantities of Rn, Tn, and An by delayed coincidences has been developed. The isotopes are continually swept from a solution containing their parents into an α-proportional gas counter. Some deep-sea cores were dated and no loss of Ra by diffusion could be found. — Author's abstract

01440 **Hide, Raymond.** Comment on a paper by M. Nafi Toksöz, Jafar Arkani-Hamed, and Curtis A. Knight, "Geophysical data and long-wave heterogeneities on the Earth's mantle" [1969]: Jour. Geophys. Research, v. 75, no. 11, p. 2141, 1970.

It is noted that the Toksöz paper [ibid., v. 74, no. 15, p. 3751-3770, 1969] erroneously states that Hide and Horai have suggested (1968) that the lower mantle is free from horizontal variations in its properties. Rather, Hide and Horai deduced hypothetical contour maps of the topography of the core-mantle interface from the observed gravitational field at the Earth's surface on the basis of a model in which heterogeneities in the mantle are neglected in the first instance, and suggested that convection in the lower mantle might be required to account for any horizontal stresses there associated with the core-mantle interface topography. — GV

09060 **Higgins, C. M.** Pressuremeter correlation study: Highway Research Rec. 284 (Natl. Acad. Sci. Pub. 1661), p. 51-60, illus.; closure to discussion p. 62, 1969.

Shear strengths of cohesive soils obtained by the Menard pressuremeter system are compared with those conventionally obtained. Results of consolidated undrained triaxial tests, run at a constant strain rate of 0.05 in/min with no pressure measurements, are in terms of total stress and for comparison, are given in graphical form as the maximum shearing strength at the effective overburden pressure. Correlation was very good for soft fairly uniform soils, but the pressuremeter showed consistently higher strengths than conventional tests in samples interspersed with different materials, or other types of discontinuity; conventional test strengths are probably those of the weakest areas in the cores. The pressuremeter is portable and performs tests *in situ*, but is extremely sensitive to hole size, sharp aggregates may burst the probe, and special methods are required for noncohesive soils. — GDC

Higgins, Michael W. *See* Zietz, Isidore. 08887

08902 **High, C.; Hanna, F. K.** Micro erosion measurements made in Jamaica in 1967, *in* Limestone geomorphology, a study in Jamaica: Cave Sci., v. 6, nos. 43-44, p. 149-150, 1969.

In measuring actual lowering of a rock surface due to erosion by a technique documented in Hanna (1966) and more fully in High and Hanna (in press), principal concerns in Jamaica were: how lithology influences rate of erosion of exposed limestone surfaces; and given similar lithologies, how the erosion rate of exposed limestone surfaces varies with annual precipitation. The Maroon Town area has nearby outcrops of both Yellow and White Limestones, while the Montpelier facies is not far distant; spacial distribution of rainfall is not as uniform as wished, but it should be possible to establish differential weathering properties of these lithologies. The Hellshire Hills, near Kingston, have microlithology very similar to the White Limestone around Maroon Town; comparison of erosion in the two areas may show relation between precipitation and superficial erosion. For reliable estimate, a revisit is proposed after a lapse of five years. — GDC

01781 **Hill, Robin E. T.; Boetticher, A. L.** Melting relationships in basalt-H_2O and basalt-H_2O-CO_2 to 30 kilobars [abs.]: EOS, v. 51, no. 4, p. 438, 1970.

01457 **Hobson, George D.; Hunter, J. A. M.; Scott, J. S.** A shallow seismic survey, elastic constants studies and surficial geology of part of Defence Research Establishment Suffield (DRES), Suffield, Alberta: Canada Geol. Survey Paper 69-13, 24 p., illus., geol. map, 1970.

A hammer refraction seismic survey was conducted over the Watching Hill and Drowning Ford areas of DRES to investigate in detail the overburden materials and stratification within the overburden, and bedrock topography and lithology. Seismic control was concentrated at or near former and anticipated blast sites. Details are presented in several sections and contoured maps. A seismic survey was also conducted at a site near Brutus radio tower to investigate the feasibility of establishing a seismic vault as part of the permanent seismic network of Canada; correlations have been made between seismic velocities and geology. The surficial geology of part of DRES was mapped on a reconnaissance scale. An attempt was made to develop a method of measuring the dynamic elastic constants of soils in situ using a portable hammer seismograph; some of the techniques employed are described. — *from* Authors' abstract

01782 **Hodge, Dennis S.; Jurdy, Donna M.** Numerical analysis of temperature distribution around intrusives [abs.]: EOS, v. 51, no. 4, p. 446, 1970.

Hoffer, Roger M. *See* Tanguay, Marc G. 09005

Holdaway, M. J. *See* Haas, Herbert. 01771

Homuth, E. F. *See* Boucher, Gary W. 01626

01523 **Hooke, Roger LeB.** Sediment measurement techniques — [Pt.] A, Fluvial sediment — Discussion [of paper 6756 by Am. Soc. Civil Engineers (Task Comm. on Preparation of Sedimentation Manual), 1969]: Am. Soc. Civil Engineers Proc., v. 96, Jour. Hydraulics Div., no. HY 4, p. 1073-1074, illus., 1970.

Attention is called to an error in paper 6756 (ibid., v. 95, no. HY 5, p. 1477-1514) which is commonly made in discussing velocity and suspended-sediment distribution in a meander bend, also the statement that velocity increases toward the outside of the bend overlooks a zone of high velocity commonly occurring near the inside of the bend. A reorientation of thinking on bed geometry in meanders may be in order. — ESL

01861 **Hopkins, Herbert T.** Occurrence of fresh water in the Lee Formation in parts of Elliott, Johnson, Lawrence, Magoffin, and Morgan Counties, Eastern Coal Field region, Kentucky: U.S. Geol. Survey Water-Supply Paper 1867, 44 p., illus., tables, geol. map, 1970.

Fresh water at saline depth in the Lee Formation of Pennsylvanian age, the result of precipitation flushing over the past 270 m.y., entered through a series of outcrops on structural highs, and discharged through flanking erosional outcrops in the valleys of Paint and Blaine Creeks and Little Sandy River and their tributaries. A flow-net analysis over one-third of the study area indicates that ground-water discharge into Paint Creek from the Lee Formation is about 600,000 gpd; expected yields may be 10 to 15 gpm from shallow wells in outcrop areas to 25 gpm from deep wells away from outcrop areas. Quality of the water is excellent, except for iron frequently in excess of 0.3 mg per liter. Contamination by brines may be from upward movement through abandoned oil- and gas-test wells drilled to underlying Mississippian and Devonian rocks, and from downward movement of high chloride water from surface streams. — GDC

01447 **Horai, Ki-iti; Nur, Amos.** Relationship among terrestrial heat flow, thermal conductivity, and geothermal gradient: Jour. Geophys. Research, v. 75, no. 11, p. 1985-1991, illus., table, 1970.

Correlation and regression analysis of terrestrial heat flow Q and thermal conductivity K show that Q and K are not independent in many of the continental areas. The refraction of heat flux due to inhomogeneous conductivity, and the proportionality between radioactive heat generation and thermal conductivity are possible explanations. — Authors' abstract

Hoskins, E. L. *See* Raleigh, C. B. 01627

Hospers, J. *See* VanAndel, S. I. 08959

01783 **Hostetler, Paul B.; Siebert, Robert M.; Christ, Charles L.** Thermodynamic solubility of sepiolite [abs.]: EOS, v. 51, no. 4, p. 453, 1970.

Howard, James D. *See* Frey, Robert W. 09129

09095 **Hruby, Ronald J.; Ragent, Boris; Edgerton, Alvin T.** An experimental evaluation of the basic assumptions used in the analysis of microwave radiometric ground truth data, *in* Symposium on remote sensing of environment, 6th Internat., Ann Arbor, Mich., 1969, Proc., V. 1: Ann Arbor, Mich., Univ. Michigan, Willow Run Labs., p. 587-602, illus., tables, 1969.

Results are reported of experimental studies to test validity of assumptions used in microwave radiometry. Four sites (sand or sand and gravel in various forms) were constructed for independent measurements of emissivity, absorptivity, and reflectivity for a range of microwave absorber properties similar to those in nature. Emissivity and absorptivity data agreed with each other sufficiently to ensure confidence in assumptions and analytical procedures used for rough radiometric applications such as gross imaging; there were sufficient discrepancies from surface effect and procedures, however, to raise questions about interpretations and measurements of

small temperature differences for moisture content analysis or geologic structure. — *from* Authors' abstract

Huff, Lewis L. *See* Hagist, Warren M. 01709

01482 **Huffman, Claude, Jr.; Riley, Leonard B.** The fluorimetric method — Its use and precision for determination of uranium in the ash of plants, *in* Geological Survey research 1970, Chap. B: U.S. Geol. Survey Prof. Paper 700-B, p. B181-B183, illus., tables, 1970.

The fluorimetric method for determining uranium in the parts-per-million range in plant ash and a study of its precision are presented. The precision of results in the range from 0.4 to 35 ppm uranium in plant ash is expressed by a simple equation (standard deviation = 0.15 + 0.063 U, where U is the observed uranium concentration in parts per million). This equation is based on 326 pairs of determinations, made during a period of about a year, on samples consisting of ash from sagebrush, piñon pine, ponderosa pine, and juniper. — Authors' abstract

01518 **Hunt, Bruce W.** Exact flow rates from Dupuit's approximation: Am. Soc. Civil Engineers Proc., v. 96, paper 7140, Jour. Hydraulics Div., no. HY 3, p. 633-642, illus., 1970.

Certain problems in three-dimensional, confined and unconfined, ground water seepage are reduced to two-dimensional boundary-value problems by integrating the exact equations of motion in the vertical direction. It is shown that the solution of these two-dimensional boundary-value problems gives exact flow rates, and that these flow rates are identical to those obtained from the classical Dupuit theory of ground water motion. It is also concluded that free surface coordinates and piezometric head distributions are not, in general, given exactly by the Dupuit formulation. — ASCE abstract

01520 **Hunt, Bruce W.** Unsteady seepage toward sink beneath free surface: Am. Soc. Civil Engineers Proc., v. 96, paper 7202, Jour. Hydraulics Div., no. HY 4, p. 859-869, illus., 1970.

One of the mathematical techniques of linearized wave mechanics is applied to solve the problem of unsteady, axially symmetric seepage toward a sink of variable strength located beneath a free surface. Both finite and infinite aquifer depths are considered, and linearized solutions are given for two distinct types of problems. The first solution corresponds to the problem in which the flow rate to the sink is a specified function of time, and the distribution of piezometric head is unknown. The second solution corresponds to the inverse problem in which the piezometric head near the sink is a specified function of time, and the flow rate to the sink is unknown. Coordinates of the free surface are determined as part of the solution in each case. Finally, it is pointed out that the results can also be used to solve the analogous problem which occurs when an aquifer is recharged by a point source. — ASCE abstract

Hunter, J. A. M. *See* Hobson, George D. 01457

Hyndman, Roy D. *See* Rankin, Douglas S. 01818

09054 **Idyll, C. P.** (editor). Exploring the ocean world — A history of oceanography: New York, Thomas Y. Crowell Co., 280 p., illus., 1969.

This book reviews the history of oceanography, a composite of all the basic sciences that use their techniques and accumulated knowledge to solve problems of the oceans. It includes ten papers (3 cited separately) on physical, chemical, biological and geological oceanography as well as aspects of the ocean's relation to man and man's use of the ocean, such as fishery science, mineral and energy extraction, archeology and aquaculture. — EH

01431 **Imlay, Ralph W.; Jones, David L.** Ammonites from the *Buchia* zones in northwestern California and southwestern Oregon: U.S. Geol. Survey Prof. Paper 647-B, p. B1-B59, illus., tables, 1970.

Ammonites from *Buchia*-bearing beds of California and Oregon date those beds and associated species of *Buchia* as latest Jurassic to earliest Cretaceous. *Buchia piochii* (Gabb) and *B.* aff. *B. okensis* (Pavlow) are dated as Tithonian, *B. uncitoides* (Pavlow) as Berriasian, and the higher *Buchia* species as Valanginian. Tithonian ammonites include *Kossmatia, Parodontoceras, Substeueroceras, Blanfordiceras,* and *Proniceras.* Berriasian ammonites include *Spiticeras* (*Negreliceras*) and *Neocosmoceras.* Valanginian ammonites include *Neocomites, Thurmanniceras, Kilianella, Sarasinella, Polyptychites, Olcostephanus* and *Tollia.* The highest Valanginian beds also contain *Crioceratites, Neocraspedites,* and *Homolsomites.* Most ammonites are of southern origin. Only *Tollia* and *Homolsomites* of Valanginian age are distinctly Boreal. — RWI

01604 **Iorwerth, H. ab.** Magnetic grain fabric of sedimentary rocks [abs.]: Am. Assoc. Petroleum Geologists Bull., v. 54, no. 3, p. 561-562, 1970.

08958 **Irving, E.** Outline of the palaeomagnetic method of determining ancient Earth radii [abs.], *in* The application of modern physics to the earth and planetary interiors (S. K. Runcorn, editor): London and New York, Wiley-Interscience, p. 111, 1969.

Isbell, William M. *See* Gregson, Victor G., Jr. 01769

01422 **Iturralde-Vinent, Manuel A.** Neogene stratigraphy in western Cuba — New data: Am. Assoc. Petroleum Geologists Bull., v. 54, no. 4, p. 658-661, illus., 1970.

The Neogene lighofacies complex in the southern part of Piñar del Rio Province can be divided into two subcomplexes. The first, in the Palacios basin, consists of 1,000 m of Aquitanian through Vindobonian carbonate and terrigenous clastic strata. The second subcomplex, outside of the Palacios basin, consists of 800 m of carbonate rocks, in which Aquitanian strata are absent and the post-Aquitanian Miocene overlies the Paleogene directly. — *from* Author's abstract

Jachens, R. C. *See* Kuo, J. T. 01674

01784 **Jackson, Dallas B.; Swanson, Donald A.** 1968-70 Kilauea deformation — East rift [abs.]: EOS, v. 51, no. 4, p. 441, 1970.

Jackson, Dallas B. *See* Swanson, Donald A. 01840

01483 **Jacobs, M. L.; Warren, C. G.; Granger, H. C.** Chemical extraction of an organic material from a uranium ore, *in* Geological Survey research 1970, Chap. B: U.S. Geol. Survey Prof. Paper 700-B, p. B184-B186, table, 1970.

Organic material associated with uranium ore in the Ambrosia Lake mining district, N. Mex., is difficult to separate from inorganic contaminants by physical methods, is highly insoluble, and nearly opaque to both visible and infrared spectra. Thorough characterization by modern methods must be preceded by purification and solution or volatilization without significant chemical changes. This study involves tests in which the material was found to be virtually insoluble in 15 diverse solvents, although as much as 30 percent was extracted by dimethyl sulfoxide. The dimethyl sulfoxide-soluble fraction consisted of a uranium-rich organic material in one deposit and a uranium-molybdenum-rich organic material in the other. Infrared absorption spectra indicated the extracted material contains carboxyl functional groups. Data obtained from chemical studies and the mass spectrometer, and infrared spectra, indicated the extract contains an aromatic component. — *from* Authors' abstract

01634 **Jacoby, Wolfgang R.** Active diapirism under mid-oceanic ridges [abs.]: EOS, v. 51, no. 3, p. 204, 1970.

01623 **James, D. E.** Model seismology: Carnegie Inst. Washington Year Book 68, 1968-69, p. 462-471, illus., table, 1970.

01420 **James, W. R.** Regression models for faulted structural surfaces: Am. Assoc. Petroleum Geologists Bull., v. 54, no. 4, p. 638-646, illus., 1970.

Mildly deformed structural surfaces with high-angle faults of moderate displacement can be approximated only poorly with standard polynomial regression models. Discontinuities can, however, be introduced into the regression equations and the least-squares criterion used to estimate parameters simultaneously describing the position of a fault, amount and direction of displacement along the fault plane, and coefficients of the polynomial regression model. This paper treats two simple models for such a fault: (1) where the fault plane is vertical and only vertical translation has occured and (2) where the fault plane is vertical and both vertical and lateral translations have occurred. The models are applied to structural data from the Ramsey pool, Payne County, Okla., where there is evidence of a high-angle fault in the subsurface. — *from* Author's abstract

09089 **Janssens, A.** Devonian outcrops in Columbus, Ohio, and vicinity, Field Trip 1 *in* Geol. Soc. America, North-Central Sec., 3d Ann. Mtg. 1969, Field Trip Guidebook: Columbus, Ohio, Ohio Div. Geol. Survey, p. 1-1 — 1-22, illus., 1969.

Middle and Upper Devonian rocks crop out in a north-south belt through central Ohio, owing to a slight eastward regional dip. The field trip studied sections at four locations in the Columbus area. In the first quarry the Silurian-Devonian contact between the Raisin River dolomite and Columbus Limestone is shown; the second quarry has a sequence from the Silurian dolomite through the Columbus Limestone, with the Delaware Limestone above it; at the site of the type section of Olentangy Shale, the shale lies above the Delaware Limestone and below the Ohio Shale. The Devonian carbonate stratigraphy in eastern Ohio is summarized. East of the outcrop in central Ohio, information about the stratigraphy decreases, as there are subtle changes in lithology, thinning out and thickening, and multiple unconformities. — EH

Javoy, Marc. *See* Montigny, Raymond. 01636

Jeffery, H. G. *See* Emmett, L. F. 01530

Jenkins, Graham. *See* Hays, James D. 01429

Jepsen, A. F. *See* Ward, S. H. 08886

Jerabek, L. A. *See* VanVoast, W. A. 01531

08943 **Jewell, John W.** An oil and gas evaluation of north Alabama: Alabama Geol. Survey Bull. 93, 64 p., illus., tables, 1969.

The Tuscumbia Limestone (Mississippian) and underlying sedimentary formations were evaluated for oil and gas in a six-county area on the south flank of the Nashville dome in northern Alabama and were compared with producing formations on the north flank of the dome in southern Kentucky. Stratigraphic cross sections, isopach maps and structural contour maps were prepared for northern Alabama and detailed maps prepared for parts of Kentucky. Porous zones were found in restricted areas in the Tuscumbia, Catheys and Bigby-Cannon Limestones, and, more generally, in the Knox Group, the most promising potential reservoir rock which should be further explored, as should the many anticlinal structures on the south flank of the Nashville dome. — *from* Author's abstract

01610 **Jobson, Harvey E.; Sayre, William W.** Vertical transfer in open channel flow: Am. Soc. Civil Engineers Proc., v. 96, paper 7148, Jour. Hydraulics Div., no. HY 3, p. 703-724, illus., table, 1970.

Vertical turbulent mass transfer coefficients for suspended sediment and dye, and fall velocities of sediment particles were determined experimentally in a laboratory flume; local values were determined from an integrated form of the transfer equation. Results of experiments indicate that: magnitude and distribution of the vertical turbulent mass transfer coefficient for dye and fine sediment are close to those of the

momentum transfer coefficient, which lends added support to Reynolds' analogy for equivalence of mass and momentum transfer in turbulent shear flow; in comparison with dye, the mass transfer coefficient for medium sand is somewhat less in magnitude and its distribution indicates that the transfer coefficient is larger near the bed; and fall velocity of sediment particles is larger in turbulent channel flow than in quiescent water. — *from* ASCE abstract

08972 **Johnson, C. E.** Mössbauer effect studies of magnetic minerals, *in* The application of modern physics to the earth and planetary interiors (S. K. Runcorn, editor): London and New York, Wiley-Interscience, p. 485-496, illus., 1969.

An outline is given of possible applications of the Mössbauer effect of study of magnetic minerals [iron compounds, iron spinels, goethite]. The speed and relative simplicity of the measurements, and the detail and variety of information which they can yield on the state of iron atoms make the technique very powerful. — *from* Author's conclusions

09021 **Johnson, J. Harlan.** A review of the Lower Cretaceous algae: Colorado School Mines Prof. Contr. 6, 180 p., illus., tables, 1969.

Sixty-seven genera of Early Cretaceous algae, mainly calcareous, are reviewed from the literature and illustrated with 69 plates: 18 genera are red algae, 25 are green, 10 are charophytes, and 14 are schizophytes (blue-green) or of uncertain affinities. Information for each genus includes summary description, remarks, stratigraphic range, geographic distribution, and tabulated dimensional and other data on the included species. Most of the 70 bibliographic references were published within the past 20 years. Practically all marine material studied comes from areas that were covered by Late Cretaceous warm shallow seas, such as the Gulf Coastal Plain, notably in Texas and Mexico, the Mediterranean region, Middle East, and Japan; charophytes occur in nonmarine deposits, notably in western interior North America. — VMJ

Johnson, Ross B. *See* Kleinkopf, M. Dean. 01468

Joiner, Thomas J. *See* Moore, Donald B. 08909

01785 **Jolly, Wayne T.** Evolution of Cretaceous calc-alkaline magmas of southern Puerto Rico [abs.]: EOS, v. 51, no. 4, p. 441-442, 1970.

Jones, D. J. *See* Lewis, D. W. 01663

Jones, David L. *See* Imlay, Ralph W. 01431

01575 **Jones, Hershel Leonard.** Petrography, mineralogy, and geochemistry of the chamositic iron ores of north-central Louisiana [abs.]: Dissert. Abs. Internat., Sec. B, Sci. and Eng., v. 30, no. 9, p. 4208B-4209B, 1970.

Jones, John F. *See* Trescott, Peter C. 01608

08953 **Jordan, P.** On the possibility of avoiding Ramsey's hypothesis in formulating a theory of Earth expansion, *in* The application of modern physics to the earth and planetary interiors (S. K. Runcorn, editor): London and New York, Wiley-Interscience, p. 55-63, table, 1969.

Dirac's suggestion that the 'gravitational constant' G is not a constant but a physical value slowly decreasing with cosmologic evolution infers marked expansion of the Earth. If there is no expansion of the Earth, there must exist some compensating compressional feature, or if there is not sufficient compensation, then expansion must be inferred from oceanic spreading. The latter hypothesis is discussed here, assuming no more than 10 percent compensation, and it is shown that the Earth's radius in Carboniferous time may have been about 80 percent of its present value. It is postulated that the sial layer completely covered the initial Earth in spherical symmetry and equal thickness, the radius being about 65 percent of the present, and ex-

pansion up to Carboniferous was an elastic process. Expansion since Carboniferous is attributed to segregation of dissolved material from the core in the young mantle below the Byerly sphere. — VSN

01717 **Judy, Clark; Melman, James R.; Friedman, Irving.** Deuterium variations in an annual snowpack: Water Resources Research, v. 6, no. 1, p. 125-129, illus., tables, 1970.

Deuterium samples taken during the 1967-68 snow year in the Rocky Mountains of Colorado indicate that metamorphism and melt of the snowpack greatly reduces the large initial variability in deuterium content of individual snowfalls. New snow values ranged from -229 to -106 per mille D relative to SMOW (Standard Mean Ocean Water). The range in the snowpack profile on May 3, 1968, was -182 to -158. This homogenization would reduce the problems involved in following snowmelt through the hydrologic system. — Authors' abstract

Jurdy, Donna M. *See* Hodge, Dennis S. 01782

01417 **Juskevice, John A.** On computerized collections: Geol. Soc. America Bull., v. 81, no. 5, p. 1597-1600, tables, 1970.

A system for computerizing a paleontologic collection is described. By limiting the initial capabilities of the system, it was possible to quickly produce a system that includes flexibility and ease of operation. The system is immediately useful because it can be implemented on a portion of a collection and assumes the clerical duties of a card file, label maker, and list maker. Programs can be written in Fortran, the most commonly used language in science. — Author's abstract

Kachadoorian, Reuben. *See* Sainsbury, C. L. 01464

01585 **Kafescioglu, Ismail Ali.** Quantitative distribution of foraminifera on the continental shelf and uppermost continental slope off Massachusetts, eastern United States [abs.]: Dissert. Abs. Internat., Sec. B, Sci. and Eng., v. 30, no. 9, p. 4282B, 1970.

Kallberg, Razel Wittels. *See* Brace, William F. 01409

Kamb, Barclay. *See* Harrison, W. D. 01777

01786 **Kamb, Barclay.** Results of a quantitative theory of glacier sliding applied to field measurements [abs.]: EOS, v. 51, no. 4, p. 431, 1970.

09015 **Kanasewich, E. R.; Savage, J. C.** Dirac's principle of cosmology and radioactive dating, *in* The application of modern physics to the earth and planetary interiors (S. K. Runcorn, editor): London and New York, Wiley-Interscience, p. 35-46, illus., tables, 1969.

A tabular comparison is made of published isotopic data from 11 terrestrial minerals, 14 stone meteorites, and 4 carbonaceous chondrites. From this it can be seen that the Rb-Sr ages of terrestrial samples systematically tend to be small owing to loss of radiogenic Sr by diffusion, but Rb-Sr ages of meteorites are less affected by this error. If these presumptions are corrent, it follows that the least squares analysis presented here would be biased in favor of the Dirac theory of beta decay. However, the analysis favors the Rutherford theory, suggesting that the systematic errors are minor; this theory appears to be more consistent with the data than the Dirac theory. — VSN

09107 **Kane, Harrison.** Consolidation of two loessial soils: Highway Research Rec. 284 (Natl. Acad. Sci. Pub. 1661), p. 26-36, illus., tables, 1969.

The open structure of loess can lead to large compressive deformations when applied stresses exceed the strength of the clay binder. The relation of consolidation properties of undisturbed loess to water content, clay content, and density was investigated to explain the behavior. Hand-carved samples from two loess deposits in east-central Iowa were subjected to consolidation tests at water contents modified in a range from

4 to 32 percent; natural densities and clay contents were 86 pcf and 19 percent for one and 91 pcf and 8 percent for the other. The maximum pressure prior to collapse of the structure increased with water contents below critical point but was constant at high water contents. At pressure levels below that causing collapse, a higher clay content reduced the compressibility, which at higher presures depended on initial density. — *from* Author's abstract

Kaplan, I. R. *See* Belsky, T. 01864

08904 **Karlstrom, Thor N. V.; Ball, George E.** (editors). The Kodiak Island refugium, its geology, flora, fauna and history: Toronto, Ontario, Ryerson Press (for Boreal Inst., Univ. Alberta), 262 p., illus., tables, 1969.

The multidiscipline Kodiak Island Refugium Expedition in Alaska was planned to determine if a biota persisted there during the Pleistocene glacial periods, and its nature; to study distribution patterns of its extant organisms and to seek clues to their past distribution. Cited individually are Karlstrom's introduction, Chap. 1 by C. H. Lindroth on the biological importance of Pleistocene refugia, and Chap. 2 by Karlstrom on the regional setting and geology. Part 3, botanical investigations, has four chapters devoted to: vascular plants, bryophytes, lichens, and Chrysophyceae, noting which species were most likely to have survived glaciation. In the five chapters of Part 4, zoological investigations, evidences of preglacial arrival are noted among the living species listed and described. In the concluding Chap. 12, Lindroth remarks on the importance of this refugium for survival of biota. — GDC

08905 **Karlstrom, Thor N. V.** Introduction, *in* The Kodiak Island refugium, its geology, flora, fauna and history (T. N. V. Karlstrom and G. E. Ball, editors): Toronto, Ontario, Ryerson Press (for Boreal Inst., Univ. Alberta), p. 2-6, illus., 1969.

An isolated, ice-free area on Kodiak Island, located during photogeologic mapping in southern coastal Alaska, provided opportunity for intensive study of the biota to test hypotheses on persistence, modification, and dispersal of plants and animals within and from a Pleistocene glacial refugium. This book attempts to reconstruct the physical environment of the refugium from present available geological data, to analyze the biological samples for species that may have survived the late-Quaternary glaciations of the region, and to delineate remaining problems and suggest avenues for continuing research in all the disciplines involved. Identifications include species previously unreported from Kodiak Island, Alaska, and North America. Some of the new ranges reflect gaps in prior biologic knowledge. — GDC

08985 **Karlstrom, Thor N. V.** Regional setting and geology, Chap. 2 *in* The Kodiak Island refugium, its geology, flora, fauna and history (T. N. V. Karlstrom and G. E. Ball, editors): Toronto, Ontario, Ryerson Press (for Boreal Inst., Univ. Alberta), p. 20-54, illus., table, 1969.

In the largest island of the Kodiak Archipelago, the smooth southwestern coastline contrasts with glacially scoured straits and fjords of the region. Alpine peaks of 3,000 to 4,000 feet expose a granitic massif along the island's axis; elsewhere lower ridges are ice-rounded. Bedrock, pre-Mesozoic to Tertiary, has granitic intrusions. The Pleistocene refugium is confined by two broad differing morainal complexes, the latest recording three main interglacial intervals of retreat. Named subdivisions, in drift strata and terraces, include proglacial lake deposits and marine deposits of higher sea levels; correlation with Cook Inlet chronology and continental sequences is documented radiometrically as well as by shells. Arrival times of oldest persisting biota, subsequent additions, modification interval, and migration are surmised; land connections may have persisted to the Sangamon or Port Talbot interglacial interval. — GDC

01561 **Kay, Beverley David McClure.** The heat of compression of Na-montmorillonite systems [abs.]: Dissert. Abs. Internat., Sec. B, Sci. and Eng., v. 30, no. 9, p. 3942B, 1970.

01787 **Kay, Robert; Gast, Paul W.** Rare earths and europium anomalies in undersaturated basaltic rocks [abs.]: EOS, v. 51, no. 4, p. 450, 1970.

Keefer, W. R. *See* Witkind, I. J. 01466

01788 **Keith, M. L.** Ocean floor convergence, a contrary view of global tectonics [abs.]: EOS, v. 51, no. 4, p. 430, 1970.

Kelleher, John. *See* Savino, John. 01633

01526 **Kemp, Patrick H.; Plinston, David T.** Beaches produced by waves of low phase difference — Closure [to discussion of paper 6100, 1968]: Am. Soc. Civil Engineers Proc., v. 96, Jour. Hydraulics Div., no. HY 5, p. 1197, 1970.

Kemp and Plinston offer the following comments to discussion by Chandrasekhara and Muddappa. The transformation from Fig. 4 to Fig. 5 (ibid., v. 94, no. HY 5, p. 1183-1195, 1968) illustrates that the grain size is most important under surging conditions, and that for plunging conditions, an approximately constant beach slope is unaffected by grain size; they doubt that replotting data would result in any further clarification. When discussing relative magnitude of energy losses with beach slope, it is important to note that losses quoted are relevant only to equilibrium conditions. — ESL

Kennedy, M. J. *See* Williams, Harold. 01505

01512 **Kentner, Edward; Zeitlin, Harry.** A rapid method for the determination of cobalt in seawater: Anal. Chim. Acta, v. 49, no. 3, p. 587-590, table, 1970.

Cobalt is one of the more difficult trace ions to determine in seawater, the usual procedure requiring a time-consuming preconcentration. A procedure is described which makes possible the determination of cobalt by solvent extraction with 1-nitroso-2-naphthol followed by spectrophotometric determination of the 1-nitroso-2-naphthol chelate. A complete analysis can be achieved in less than an hour. — ESL

09017 **Kenyon, Dean H.; Steinman, Gary.** Biochemical predestination: New York and London, McGraw-Hill Book Co., 301 p., illus., tables, 1969.

The aims of this book are to present in detail what the authors (organic and biophysical scientists) consider the major experimental approaches to the origin of life problem and also to evaluate critically the underlying assumptions (as well as the explicitly stated hypotheses) upon which current work is being carried out. The seven chapters are titled: nature of the origin of life problem; antiquity of terrestrial life — concept of absolute age, geologic column, radioactive isotopes as geologic clocks, surviving traces of Precambrian life; reconstructing the primitive scenario; synthesis of biomonomers; dehydration condensation and polymerization; development of morphological complexity and dynamic organization; and conclusions and prospectus. References and an index are appended. — MCM

09101 **Kesling, Robert V.** A new brittle-star from the Middle Devonian Arkona Shale of Ontario: Michigan Univ. Mus. Paleontology Contr., v. 23, no. 2, p. 37-51, illus., 1969.

Discovery of a whole community of tiny ophiuroids in an exposure of Arkona Shale east of Arkona, Middlesex County, Ontario, permits description of a new species, *Eugasterella thorni*, with exceptional thoroughness. Suprageneric placement is clear (order Oegophiurida, suborder Lycophiurina, family Protasteridae), but generic placement is not so clear; *Eugasterella* is herein retained as a separate genus rather than being considered a junior synonym of *Protaster*, which has a longer stratigraphic range (Middle Ordovician-Lower Carboniferous) than seems likely for such ecologically responsive animals. The ophiuroids, occurring on the surface of the bed, are interpreted as scavengers, along with platycerid gastropods and others, which were all suddenly buried by mud while quietly feeding on a tangled mass of disarticulated crinoids. — VMJ

01473 **Ketner, Keith B.** Geology and mineral potential of the Adobe Range, Elko Hills, and adjacent areas, Elko County, Nevada, *in* Geological Survey research 1970, Chap. B: U.S. Geol. Survey Prof. Paper 700-B, p. B105-B108, illus., 1970.

Ordovician to Triassic sedimentary rocks in the Adobe Range and neighboring hills are tightly folded and broken by thrust faults; at least one episode of thrusting is of Paleozoic age. The folding and a younger episode of thrusting took place in Mesozoic or very early Tertiary time. Although Paleozoic rocks have been intruded by two sizeable stocks, metallic mineral deposits commonly associated with similar stocks in other parts of Nevada have not been found. Rocks adjacent to thrust faults and some steep faults are silicified and iron stained; some altered rocks are slightly enriched in lead and zinc. The Permian System contains many weakly phosphatic beds and a few of moderately rich phosphate rock. The lower part of the Tertiary sequence includes extensive beds of oil shale similar to the occurrence on the south edge of Elko. — *from* Author's abstract

Kharkar, D. P. *See* Turekian, K. K. 01700

08975 **King, G. C. P.; Davies, D.** A laser seismometer, *in* The application of modern physics to the earth and planetary interiors (S. K. Runcorn, editor): London and New York, Wiley-Interscience, p. 513-522, illus., 1969.

For problems and techniques involved in development and installation of a seismometer using a frequency-stabilized laser, emphasis is on emplacement, operation, and capabilities. The instrument, although not as sensitive as the Benioff quartz rod, does not require such a restrictive environment for installation, can be used for more than one experiment simultaneously, and is semiportable. The seismometer is described and illustrated and results obtained from an installation are reviewed. It should provide data for a wide variety of elasticity problems, and can be used as a short-period seismometer; for periods of a minute up to an hour it will act as a long-period seismometer with capabilities of observing surface waves and for recording free oscillations of the Earth. Beyond the hour period it will record earth tides. — VSN

King, Kenneth W. *See* Engdahl, Eric R. 01631

Kirby, S. H. *See* Raleigh, C. B. 01627

Kirk, J. N. *See* MacDonald, H. C. 09014

09106 **Kirkpatrick, W. M.** Determination of lateral pressures associated with consolidation of granular soils — Discussion [of paper by V. Obrcian, 1969]: Highway Research Rec. 284 (Natl. Acad. Sci. Pub. 1661), p. 23-25, illus., 1969.

Kirkpatrick comments on several points raised by Obrcian (ibid., p. 13-22). Two figures show that removal of the axial load from a certain stress level resulted in the recovery of a little of the applied strain, but that the majority is plastic or irrecoverable. The determined values of E' and K' can be used to construct the stress-axial strain and axial strain-volume strain curves for elastic or recoverable conditions. Assuming the remaining strains are plastic, these can be computed from the measured strains and the plastic stress-strain curves can be constructed. Such a construction for a dense sand under triaxial compression is shown. — ESL

Kleinhampl, F. J. *See* Sainsbury, C. L. 08944

Kleinkopf, M. D. *See* Witkind, I. J. 01466

01468 **Kleinkopf, M. Dean; Peterson, Donald L.; Johnson, Ross B.** Reconnaissance geophysical studies of the Trinidad quadrangle, south-central Colorado, *in* Geological Survey research 1970, Chap. B: U.S. Geol. Survey Prof. Paper 700-B, p. B78-B85, illus., 1970.

In the Trinidad quadrangle, Colorado, major gravity and magnetic anomalies correlate with the large geological features. The most conspicuous gravity anomaly in the quadrangle is a 30-milligal minimum along the east edge of the San Luis Valley. The anomaly may be caused by 20,000-30,000 feet of Tertiary and Quaternary sediments. Regional north-easterly trends in the geophysical data are interpreted as fault trends or shear zones in the crystalline basement. A large positive magnetic anomaly

of about 700 gammas amplitude and correlative gravity maximum in the northeast part of the quadrangle may indicate a buried intrabasement crystalline mass of intermediate to basic composition. This proposed intrabasement body lies along the axis of the Apishapa arch. — Authors' abstract

08929 **Klohn, M. L.; Pickens, W. R.** Geology of the Felder uranium deposit, Live Oak County, Texas [abs.]: Mining Eng., v. 21, no. 12, p. 63, 1969.

Klovan, J. E. *See* Solohub, J. T. 01535

01449 **Knight, Charles A.; LaChapelle, E.** Further observations on stress-generated ice in the Blue Glacier, Washington, U.S.A. [with French and German abs.]: Jour. Glaciology, v. 9, no. 55, p. 87-101, illus., 1970.

A detailed examination is made of stress-generated ice crystallization features discussed by LaChapelle (1968, Abstracts of North American Geology, Dec. 1968), using thin-section techniques. Crystallization features on the walls of a tunnel in Blue Glacier are localized at fine-grained layers and are fed by liquid water traveling along grain boundaries within the wall and within the deposits themselves. Water filling the crevasse encountered at the end of the tunnel was freezing uniformly to the crevasse walls as well as forming Thomson crystals within the water, and evidence points to an important role for constitutional supercooling in the Thomson crystal formation. Forms of most Thomson crystals are explainable qualitatively by heat flow effects. — *from* Authors' abstract

Knoke, R. *See* Usdowski, E. 01845

08992 **Knopoff, L.; Schwab, F. A.; Schlue, J. W.** Dispersión de ondas Rayleigh al sur del Golfo de California — The dispersion of Rayleigh waves south of the Gulf of California [Spanish and English texts], *in* Pan American symposium on the upper mantle, México, D. F., 1969—Group 5, Seismology: Geofísica Internac., v. 9, nos. 1-3, p. 3-19, illus., tables, 1969.

This study deals with the strike-slip focal mechanism determined by the single-station phase velocity method, using data from stations at Culiacán and La Paz, Mexico. Three small earthquakes were recorded at the stations for the Rivera Fracture zone off the west coast of Mexico, a zone of strike-slip earthquakes where paths of events to the two stations are short enough so that average structures obtained from inversions are considered representative. Phase responses at long periods, found for shocks in the east and west parts of the fracture zone, were similar. Phase velocities of the shocks were computed and compared with known velocities for the western Mediterranean area. Structures obtained along the lines from the earthquakes to the stations resembled those in the Mediterranean. A very strong, low-velocity anomaly may lie under the north part of the La Paz profile but its extent and depth have not yet been delineated. — EH

09117 **Knopoff, Leon.** The triggering of large earthquakes by earth tides [abs.]: EOS (Am. Geophys. Union Trans.), v. 50, no. 5, p. 399, 1969.

01414 **Komar, Paul D.** The competence of turbidity current flow: Geol. Soc. America Bull., v. 81, no. 5, p. 1555-1562, illus., 1970.

The ability of turbidity currents to transport materials can be evaluated by mathematical formulae that consider grain size, density contrast between grains and turbidity current, flow thickness, and slope. A comparison study of the Doheny channel (late Miocene Capistrano Formation, California) and the Cascadia fan (modern deep-sea deposits along the northwest coast) shows that coarse cobbles in the Doheny could be transported by turbidity currents of reasonable dimensions and density flowing down the estimated paleoslope. — EHP

01638 **Kornfeld, J. A.** Drilling will center in three areas: World Oil, v. 170, no. 6, p. 64-66, illus., 1970.

Industry will concentrate on increasing U.S. gas reserves by exploratory and development drilling in four areas where actual and potential producing zones exist at depths to 22,000 feet. The latest geologic information on important deep gas regions in Texas, Oklahoma, New Mexico and the Gulf Coast is presented. — *from* Author's abstract

01614 **Krogh, T. E.; Brooks, C.; Hart, S. R.; Davis, G. L.** The Grenville front in the Chibougamau-Surprise Lake area: Carnegie Inst. Washington Year Book 68, 1968-69, p. 408-410, illus., 1970.

Krogh, T. E. *See* Brooks, C. 01616

Krogh, T. E. *See* Brooks, C. 01617

Krogh, T. E. *See* Brooks, C. 01618

Krogh, T. E. *See* Hart, S. R. 01620

01789 **Krogh, T. E.; Davis, G. L.** Two periods of metamorphism and deformation, 1700 and 1000 m.y. ago, in the Grenville province, Ontario [abs.]: EOS, v. 51, no. 4, p. 434, 1970.

Kudo, A. M. *See* Laughlin, A. W. 01792

Kullerud, Gunnar. *See* Hafner, S. S. 01772

Kullerud, Gunnar. *See* Taylor, Lawrence A. 01842

Kulm, L. D. *See* Griggs, G. B. 01499

01674 **Kuo, J. T.; Jachens, R. C.; Ewing, M.; White, G.** Transcontinental tidal gravity profile across the United States: Science, v. 168, no. 3934, p. 968-971, illus., table, 1970.

Data obtained from a transcontinental tidal gravity profile across the United States were analyzed. Results for the principal tidal constituents M_2 and O_1 have shed light on the long-standing problem of the indirect influence of ocean tides on the solid-earth tide. The profile consists of nine observational stations distributed almost evenly around 39-41°N. across the United States. The observed values of the gravimetric factor and the phase were found to depend on the tidal characteristics of the Atlantic and Pacific oceans. There is no observable correlation between tidal gravity parameters and regional geology. When the influence of ocean tides is taken into account, it is possible for the first time to bring the gravimetric factors and phases for all the stations of a transcontinental network into a consistent system within the framework of the earth tidal theory. — Authors' abstract

01790 **Kupfer, Donald H.** Transform-fault nomenclature and the San Andreas fault [abs.]: EOS, v. 51, no. 4, p. 427, 1970.

Kushiro, I. *See* Erlank, A. J. 01621

LaChapelle, E. *See* Knight, Charles A. 01449

Lahman, H. S. *See* Vozoff, K. 08877

Lahr, John. *See* Page, Robert. 01810

01545 **Laird, M. G.** Vertical sheet structures — A new indicator of sedimentary fabric: Jour. Sed. Petrology, v. 40, no. 1, p. 428-434, illus., 1970.

Vertical or subvertical sheet-like structures occurring in a turbidite sequence are shown to be developed parallel to the direction of preferred orientation of the long axis of grains. They are interpreted as reflecting primary sedimentary fabric, and can

be used as paleocurrent indicators. The sheets are thought to represent a matrix-deficient residue of large grains formed in the upwelling portions of convection cells initiated by differential settling of grains during deposition of a bed. They may thus provide evidence of deposition from suspension of the sedimentary unit in which they occur. — Author's abstract

01791 **Lakatos, Stephen; Miller, Donald S.** Effect of water pressure on stability of fission tracks in muscovite [abs.]: EOS, v. 51, no. 4, p. 450, 1970.

01862 **Larimer, J. W.; Anders, Edward.** Chemical fractionations in meteorites — Pt. 3, Major element fractionations in chondrites: Geochim. et Cosmochim. Acta, v. 34, no. 3, p. 367-387, illus., tables, 1970.

An attempt has been made to explain the fractionations of some 20 elements, including the major constituents of chondritic matter, on the assumption that they occurred in the solar nebula in material originally of carbonaceous chondrite composition. Lithophile elements may have been fractionated at 1,300-1,350°K by partial loss of an early condensate consisting of such minerals as $MgAl_2O_4$, Mg_2SiO_4, $CaTiO_3$, and $Ca_2Al_2SiO_7$. Siderophile elements may have been fractionated between 680° and 1,050°K by partial separation of metal and silicate. Chondrite formation seems not to have been related to either of these fractionations; it may have occurred at about 700°K during or after metal-silicate fractionations, presumably by partial remelting of the dust, followed by further condensation of volatiles and accretion. — GV

01699 **Larson, Roger L.; Chase, Clement G.** Relative velocities of the Pacific, North America, and Cocos plates in the Middle America region: Earth and Planetary Sci. Letters, v. 7, no. 5, p. 425-428, illus., 1970.

Relative velocities of crustal plates are used for the first time to test the conventional assumption that such plates are rigid. Spreading rates derived from magnetic anomaly data, fracture zone trends, and earthquake mechanisms in the Pacific-North America, and Pacific-Cocos plate boundaries are used to predict the direction of thrusting of the Cocos plate under North America to be 031°. As this direction is in near accord with previously determined earthquake mechanisms at the plate boundary, the assumption that the three plates are rigid appears to be largely justified. The calculated rate of underthrusting at the Cocos-North America plate boundary is about 8 cm/yr. — Authors' abstract

01792 **Laughlin, A. W.; Brookins, D. G.; Kudo, A. M.; Causey, J. D.** Sr isotopic and chemical analyses of lherzolite inclusions and basalt, Bandera Crater, New Mexico [abs.]: EOS, v. 51, no. 4, p. 449, 1970.

01793 **Laughlin, A. William; Causey, J. D.** Phlogopite-kaersutite bearing ultramafic inclusions from a new locality, Bandera Crater, Valencia County, New Mexico [abs.]: EOS, v. 51, no. 4, p. 449, 1970.

09103 **Lee, Keenan.** Infrared exploration for shoreline springs at Mono Lake, California, test site, *in* Symposium on remote sensing of environment, 6th Internat., Ann Arbor, Mich., 1969, Proc., V. 2: Ann Arbor, Mich., Univ. Michigan, Willow Run Labs., p. 1075-1100, illus., table, 1969.

This study investigated the ability of a nonclassified, airborne infrared scanner to detect and evaluate shoreline springs. Infrared data were collected on four different missions using the Bendix scanner operating in the 2-5.5 and 8-14 μm windows. The test site contained numerous fresh-water springs of various temperatures and rates of flow discharging around and under Mono Lake, Calif. Mono Lake is a saline lake and thus analogous to marine conditions. Springs discharging a fraction of a liter/sec have been recognized on imagery, and under favorable conditions can be detected where there is no temperature difference between spring water and surface of the open salt water. Sublake fresh water normally is not apparent on imagery except under special conditions. Volumetric discharge from shoreline springs at Mono Lake can be estimated from imagery if air temperature at ground level is known. Discharge rates of 11 springs were estimated. — *from* Author's abstract

01794 **Leeman, W. P.; Manton, W. I.** Sr-87/Sr-86 ratios of Snake River Plain basalts [abs.]: EOS, v. 51, no. 4, p. 444, 1970.

Leeper, Robert H. *See* Helgeson, Harold C. 08942

08981 **Leibhardt, Maidi.** Im Jagdegebiet des Tully Monsters: Natur u. Mus., v. 99, no. 12, p. 552-558, illus., 1969.

In the Pennsylvanian coal-stripped area near Springfield, Ill., collector Francis Tully in 1958 found, flattened in a concretion from the Francis Creek Shale, the worm-like fossil described by Richardson (1966) as *Tullimonstrum gregarium*. Here reviewed, its description is compared with other finds, and the half-fish, half-worm morphology is sketched and discussed, particularly the fanged head, tail form, and the black pigmented eye-like parts. Some examples are preserved in pyrite of clay layers. Based on fragments in two collections, an illustrated reconstruction model suggests an average length of 25.5 cm. In the Leibhardt collection is a mold of the central part of a half body that must have been at least 45 cm long. — GDC

Lewis, A. J. *See* MacDonald, H. C. 09014

01663 **Lewis, D. W.; Lingen, G. J. van der; Jones, D. J.** The construction of a transparent grain-size comparator: Jour. Sed. Petrology, v. 40, no. 1, p. 472-474, illus., 1970.

Details of the construction of a perspex grain-size comparator are given. Although the idea of a comparator is not new, the durability and transparency of this one provide many advantages over others we have seen. It is very popular amongst officers of the New Zealand Geological Survey, and is a very useful teaching aid for students. — Authors' abstract

01477 **Lewis, G. Edward.** New discoveries of Pleistocene bisons and peccaries in Colorado, *in* Geological Survey research 1970, Chap. B: U.S. Geol. Survey Prof. Paper 700-B, p. B137-B140, illus., 1970.

Three taxa of mammals are recorded from Colorado: *Bison* (*Gigantobison*) *latifrons* from Sangamon deposits of the Canon City area; *Bison* (*Simobison*)*? alleni*, from lower Wisconsin deposits of the Denver area; and *Platygonus compressus* from upper Wisconsin deposits in Denver. — Author's abstract

Liebermann, R. C. *See* Anderson, O. L. 08969

Liebermann, Robert C. *See* Savino, John. 01633

08906 **Lindroth, Carl H.** The biological importance of Pleistocene refugia, Chap. 1, *in* The Kodiak Island refugium, its geology, flora, fauna and history (T. N. V. Karlstrom and G. E. Ball, editors): Toronto, Ontario, Ryerson Press (for Boreal Inst., Univ. Alberta), p. 7-17, 1969.

South of the Pleistocene circumpolar icesheets, glacial refugia were open-type, on loess or tundra and steppe, and rare unglaciated mountains; in Arctic regions, closed-type, ice-free areas called nunataks and coastal refugia, were completely surrounded by ice or bordering the sea, as on Kodiak Island. The Swedish botanists' concept of glacial refugia was reluctantly adopted by zoologists to explain disjunct distribution of biota. Geologists support conclusions of biogeographers, but recognize difficulties in exact dating of glacial features. The Kodiak area was first noticed by geologists, then introduced to biologists; little is known about its Pleistocene climatic conditions. Closed refugia, with unusual soil qualities, are centers of "rare" biota, but are not important for speciation; no glacial refugium is completely free of contaminating immigrants. — GDC

01550 **Lindsay, John F.; Summerson, C. H.; Barrett, P. J.** A long-axis clast fabric comparison of the Squantum "Tillite", Massachusetts, and the Gowganda Formation, Ontario: Jour. Sed. Petrology, v. 40, no. 1, p. 475-479, illus., 1970.

Long-axis clast fabrics from these two formations are dissimilar in general features. The Squantum fabrics have well-developed girdles which dip steeply down the paleoslope. The fabrics are most like those of mudflows in their general features, but dip more steeply than expected. Modes occur parallel to the strike of the paleoslope, a feature not previously observed in mudflow fabrics. The modes of the Gowganda show two subhorizontal, one parallel and the other transverse to the paleoslope. The modes are contained in broad horizontal girdles. A third fabric diagram from the Gowganda has a single well-developed subhorizontal mode parallel to the strike of the paleoslope. The Gowganda fabrics are most similar to known till fabrics. Thus, the fabrics tend to support a mudflow origin for the Squantum and a glacial origin for the Gowganda. — *from* Authors' abstract

01795 **Lindsley, D. H.; Haggerty, S. E.; Smith, Douglas.** Occurrence of aenigmatite in differentiated basalt [abs.]: EOS, v. 51, no. 4, p. 435, 1970.

Lindvall, Robert M. *See* Scott, Glenn R. 01556

01598 **Ling, Hsin-Yi.** Occurrences of silicoflagellates from central north Pacific cores [abs.]: Am. Assoc. Petroleum Geologists Bull., v. 54, no. 3, p. 558, 1970.

Lingen, G. J. van der. *See* Lewis, D. W. 01663

09006 **Link, L. E.** Capability of airborne laser profilometer to measure terrain roughness, *in* Symposium on remote sensing of environment, 6th Internat., Ann Arbor, Mich., 1969, Proc., V. 1: Ann Arbor, Mich., Univ. Michigan, Willow Run Labs., p. 189-196, illus., 1969.

Measurements were made at 12 test sites to determine the feasibility of rapidly assessing ground roughness with an airborne laser profilometer system. Test sites were selected that exhibited variations in terrain surface roughness, vegetation cover, and natural obstacles that might have an effect on military activities. The capabilities of the laser system were assessed on the basis of its ability to perceive and record these terrain features. The results of this study indicate that a laser profilometer system may be a useful tool for adjudging terrain roughness if the sources of error are eliminated. — Author's abstract

Liptai, R. G. *See* Giardini, A. A. 01763

08993 **Lomnitz, Cinna.** Explicación del error sistemático en table de distancia-tiempo de Jeffreys-Bullen — An explanation of the systematic error in the Jeffreys-Bullen travel-time table [Spanish and English texts], *in* Pan American symposium on the upper mantle, México, D.F., 1969—Group 5, Seismology: Geofísica Internac., v. 9, nos. 1-3, p. 3-19, illus., tables, 1969.

Plotting seismic traveltime from a point as a function of azimuth and distance yields a surface called a "chronoid." The chronoid for the standard Earth is a surface of revolution, termed the "standard chronoid." Local anomalies are the set of coordinate transformations required to bring the local chronoid into least-square coincidence with the standard chronoid; this is accomplished by two mutually orthogonal translations, plus one rotation in an azimuthal plane. These operations produce three distinct components of the local anomaly. One of these, the "skew anomaly," introduces a bias in the traveltime residual defined by Jeffreys. The expected value of the residual is greater than zero. The assumption that mean residual is zero leads to a systematic overestimation of standard traveltime. — *from* Author's abstract

Louisnathan, S. John. *See* Moore, Paul B. 09048

09050 **Louisnathan, S. John.** Refinement of the crystal structure of hardystonite, $Ca_2ZnSi_2O_7$ [with German abs.]: Zeitschr. Kristallographie, v. 130, nos. 4-6, p. 427-437, tables, 1969.

The structure of hardystonite, $Ca_2ZnSi_2O_7$, was refined to R = 5.3 percent from three-dimensional diffractometer data. The Zn-O and Si-O bonds are predominantly

covalent, and the adjacent covalent sheets of $[ZnSi_2O_7]^{4-}$ are linked by Ca^{2+} ions, with the interlayer bonding being predominantly ionic in character. — Author's abstract

01461 **Lovering, T. G.; Cooper, J. R.; Drewes, Harald; Cone, G. C.** Copper in biotite from igneous rocks in southern Arizona as an ore indicator, *in* Geological Survey research 1970, Chap. B: U.S. Geol. Survey Prof. Paper 700-B, p. B1-B8, illus., tables, 1970.

In the Sierrita and Santa Rita Mts. of southern Arizona, rocks from igneous intrusive bodies that are genetically associated with copper deposits contain as much as 0.03 percent copper; biotite separated from these rocks contains as much as 1 percent copper. Rocks from igneous intrusives in the same area not associated with copper deposits contain from a few ppm to a few tens of ppm of copper, and biotites separated from them contain at most 200 ppm copper. The large composite stock on the east side of the Sierrita Mts. shows a well-defined increase in copper content of biotite, from a few ppm in the northern part to as much as 1 percent near the copper deposits at its southern end. Copper anomalies in biotite in the rocks provide a more sensitive and extensive indication of associated copper mineralization than do those in whole-rock samples. — *from* Authors' abstract

01725 **Low, Philip F.; Ravina, Israela; White, Joe L.** Changes in b dimension of Na-montmorillonite with interlayer swelling: Nature, v. 226, no. 5244, p. 445-446, illus., 1970.

Recently it was observed that adsorption of one or two molecular layers of water between the layers of vermiculite increased its b dimension. An examination of montmorillonite at different water contents reveals a similar change in the b-dimension with c-axis spacing; this is attributed to strong interaction between montmorillonite and water which modifies their respective structures. Such interaction could extend to considerable depth and have a significant effect on such phenomena as swelling, supercooling, and hydraulic conductivity. — DBV

Luedke, Robert G. *See* Burbank, Wilbur S. 09025

Luth, W. C. *See* Martin, R. F. 01797

Luth, W. C. *See* Whitney, James A. 01852

08984 **Lutton, Richard J.** Natural rubble slopes and their relevance to crater fallback slopes — U.S. Army Engineer Nuclear Cratering Group Tech. Rept. 14: Alexandria, Va., Defense Documentation Center, [178] p., illus., tables, 1969.

Natural rock rubble deposits offer useful information on characteristics and behavior of crater fallback if their geomorphic histories are recognized and understood. Seven slope deposits were considered: talus, colluvial mantle, alluvium, mudflow debris, rock glaciers, moraine and modified debris. Talus is most similar to fallback. Talus slopes range to 1,600 feet or greater in height and average about 34, 33, 31, 31, and 24 degrees, respectively, in semiarid, alpine, subarctic, temperate and tropical climates. Mixing of materials by a cratering event should tend to make fallbacks slightly more stable than corresponding natural rubble. Fallback is out of equilibrium with its environment and may undergo major erosional and weathering modifications, which may produce a more stable configuration in the long run. — *from* Author's abstract

09109 **Lutzen, Edwin E.** Detecting caverns from the surface with portable geophysical equipment [abs.]: Natl. Speleol. Soc. Bull., v. 31, no. 2, p. 41, 1969.

01546 **Lynch, M. P.; Harrison, W.** Sedimentation caused by a tube-building amphipod: Jour. Sed. Petrology, v. 40, no. 1, p. 434-436, illus., 1970.

Direct measurements of changes in bottom elevation caused by a colony of tube-building amphipods, *Ampelisca abdita* Mills, were made over the period 14 November 1965 to 5 March 1966 in the York River, Virginia. Total increase in bottom elevation amounted to 108 mm. The maximum rate of increase was 39.0 mm/wk. — Authors' abstract

09014 **MacDonald, H. C.; Kirk, J. N.; Dellwig, L. F.; Lewis, A. J.** The influence of radar look-direction on the detection of selected geological features, *in* Symposium on remote sensing of environment, 6th Internat., Ann Arbor, Mich., 1969, Proc., V. 1: Ann Arbor, Mich., Univ. Michigan, Willow Run Labs., p. 637-650, illus., table, 1969.

The recent availability of multiple flight coverage from eastern Panama and northwestern Colombia has provided sufficient data for a semiquantitative look-direction analysis in which detection of certain geologic features under a variety of terrane conditions has been examined. The features selected for the study are faults, joint systems and dip slopes. Comparing the flight coverage with that of areas of the United States which have multiple pass coverage, it is apparent that look-direction does influence detectability of certain geologic features. Depending on relative topographic relief, effective incidence angle, and look-direction, geologic features can be advantageously enhanced or completely suppressed. Maximum data retrieval from radar geologic reconnaissance in poorly mapped areas necessitates imaging the specific region from 4 orthogonal look-directions. — *from* Author's abstract

09038 **MacDonald, Harold C.** Geologic evaluation of radar imagery from Darien Province, Panama: Modern Geology, v. 1, no. 1, p. 1-63, illus., tables, 1969.

Radar imagery of about 17,000 sq km in eastern Panama and northwestern Colombia provides geologic data for an area where investigations have been limited by inaccessibility and perpetual cloud cover. Objectives of the study were to determine radar utility in geologic map compilation, define and analyze radar-linears and infer nature of tectonic forces responsible for local structures, examine effect of radar-look direction and determine a possible directional dependency factor with radar systems, and evaluate potential of radar as a single reconnaissance tool in a tropical environment. A ready subdivision can be made between igneous and sedimentary rocks; large-scale structures can be synoptically studied; and relative stratigraphic sequence can be determined if lithic units are topographically expressed. With field data used in conjunction with radar imagery, resultant information far exceeds data previously available. — *from* Author's abstract

MacKevett, E. M., Jr. *See* Plafker, George. 01463

08868 **Macurda, Donald B., Jr.** Blastoids, Chap. 11 *in* History of the Redwall Limestone of northern Arizona: Geol. Soc. America Mem. 114, p. 457-473, illus., table, 1969.

Five genera and six species of blastoids present in the Redwall Limestone are described here. Only 106 specimens are known, and over half belong to *Orophocrinus*. The blastoid fauna of the Redwall has its closest affinities with the fauna of the Osage of the Mississippi Vallye. — HRC

Major, M. W. *See* Blackford, M. E. 01630

01495 **Malahoff, Alexander.** Some possible mechanisms for gravity and thrust faults under oceanic trenches: Jour. Geophys. Research, v. 75, no. 11, p. 1992-2001, illus., 1970.

Seismic reflection profiles taken across several trenches of the Pacific suggest that gravity faulting is the dominant type of tectonic deformation within the trenches. Studies made of the directions of oceanic crustal movement suggest, however, that the oceanic crust is absorbed into the mantle beneath island arcs by thrust faulting. First-motion studies of earthquakes occurring beneath the trenches suggest horizontal extension of the crust over the sea-floor level and crustal compression at about 30 km below and beneath the trench axes and the island arcs. To accommodate the concept of underthrusting of the oceanic crust under island arcs with gravity-fault deformation in the trenches, a transformed thrust mechanism is suggested as one of a possible number of mechanisms whereby a gravity fault located at the trench surface would become a thrust fault at depths of 30 to 40 km beneath the island arc. — Author's abstract

01576 **Malone, Philip Garcia.** Paleotemperature determinations from pelecypod skeletal carbonates from the Upper Pleistocene of the Atlantic Coast [abs.]: Dissert. Abs. Internat., Sec. B, Sci. and Eng., v. 30, no. 9, p. 4209B, 1970.

01474 **Mamay, Sergius H.; Breed, William J.** Early Permian plants from the Cutler Formation in Monument Valley, Utah, *in* Geological Survey research 1970, Chap. B: U.S. Geol. Survey Prof. Paper 700-B, p. B109-B117, illus., 1970.

A small assemblage of fossil plants was found in the Organ Rock Tongue of the Cutler Formation in Monument Velley, Utah. This flora is related to that of the Hermit Shale of Arizona, through the presence of *Supaia rigida* White; the Utah assemblage represents the most northerly known occurrence of the *Supaia* flora. Presence of the genus *Protoblechnum* Lesquereux in the flora (*P. bradyi*, n. sp.) suggests Asiatic relationships for the Cutler flora. — Authors' abstract

Mamet, B. L. *See* Skipp, Betty. 01475

01662 **Mandelbaum, Hugo.** Definition and properties of a variability index of deltaic sediments: Jour. Sed. Petrology, v. 40, no. 1, p. 436-445, illus., tables, 1970.

An outstanding characteristic of the deltaic sediments cored in the St. Clair River delta in Lake St. Clair, Michigan, is their great variability. The construction of a suitable index for this variability produced a very useful parameter. The statistical distribution of this variability index is log-normal. Its value increases towards more open areas of sedimentation and correlates with the increase of the mean grain size of the sedimentary column. Areas of uniform processes of sedimentation can be defined by this index in conjunction with the conventional sediment parameters. — Author's abstract

01419 **Mangelsdorf, P. C., Jr.; Manheim, F. T.; Gieskes, J. M. T. M.** Role of gravity, temperature gradients, and ion-exchange media in formation of fossil brines: Am. Assoc. Petroleum Geologists Bull., v. 54, no. 4, p. 617-626, illus., tables, 1970.

Calculations show that gravitational setting of ions in an isothermal sediment column could produce increases of equilibrium concentrations in pore waters ranging from 1 percent per 100 m depth for chloride to 4 percent per 100 m depth for strontium. The migration of ions in a thermal gradient (Soret effect) would cause minor salt enrichment upward toward the colder pole, but the presence of cation-exchanging particles such as clays would reverse this tendency and cause pumping of salt downward. A model calculation using literature data for the thermal potentials suggests that about 5-percent enrichment in Cl per 100 m depth may occur under steady-state conditions. These mechanisms do not explain the greater enrichments commonly found in subsurface brines, but may modify salt distributions due to other phenomena. — Authors' abstract

Manheim, F. T. *See* Mangelsdorf, P. C., Jr. 01419

Manheim, F. T. *See* Chan, K. M. 01658

Manke, Phillip G. *See* Townsend, Frank C. 09062

Mann, J. *See* Gelpi, E. 01683

Manton, W. I. *See* Leeman, W. P. 01794

01796 **Marchand, M.; Gray, N. H.; Green, D. H.** Ultramafic nodules from the Ile Bizard kimberlite [abs.]: EOS, v. 51, no. 4, p. 448, 1970.

Markle, David A. *See* Hemphill, William R. 09012

Marlow, Michael S. *See* Scholl, David W. 01592

01664 **Marlowe, James I.** Weddellite in bottom sediment from the St. Lawrence and Saguenay Rivers: Jour. Sed. Petrology, v. 40, no. 1, p. 499-506, illus., tables, 1970.

Weddellite has been identified from bottom sediments of the Saguenay and St. Lawrence Rivers, Canada. Identification was carried out by optical and X-ray diffraction techniques. X-ray characteristics determined on whole crystals compared

closely with characteristics of weddellite from human kidney stones and from synthesized calcium oxalate hydrates. The weddellite of this report appears to have formed authigenically in the bottom sediment, where it is associated with deposits of wood fiber. It is speculated that the mineral formed as a result of the presence of calcium oxalate, commonly found in plant cells, in interstitial water. Although an alkaline environment is necessary to its stability, other factors that favor its formation are not known. — *from* Author's abstract

Marshall, R. *See* Coker, A. E. 09093

01797 **Martin, R. F.; Luth, W. C.** Peralkaline alkali feldspar solvii [abs.]: EOS, v. 51, no. 4, p. 439, 1970.

01669 **Martin, Robert F.** Petrogenetic and tectonic implications of two contrasting Devonian batholithic associations in New Brunswick, Canada: Am. Jour. Sci., v. 268, no. 4, p. 309-321, illus., tables, 1970.

Devonian granitic rocks of New Brunswick occur in two distinct belts and differ in mineralogy, trace element chemistry, texture, and rock associations. Many features of the subsolvus-type granitic rocks from the axis of the Lower Paleozoic folded belt suggest mesozonal emplacement of a magma relatively rich in volatiles. The granites from the St. George batholith on the other hand, seem to have crystallized in the epizone, from a relatively dry melt. It is proposed that these differences in environment of emplacement account for the lack of extensive mineralization in the host rocks of the St. George batholith; they are also consistent with recent proposals that a major northeasterly-trending tectonic break separates the two batholithic belts. — *from* Author's abstract

Martinez, Joseph D. *See* Weidie, A. E. 01418

Mason, Brian. *See* Smith, J. V. 01676

01552 **Mattinson, James M.; Fisher, Richard V.** Impossibility of Bernoulli pressure forces on particles suspended in boundary layers — Reply [to J. B. Southard's (1970) criticism of original work in 1968]: Jour. Sed. Petrology, v. 40, no. 1, p. 520-521, illus., 1970.

Southard (ibid., v. 40, p. 518-519) claims that Bernoulli forces cannot work across flow lines, but rather parallel with them. The authors here describe a simple experiment in which some sort of force, or forces, operate normal to the direction of flow of a current. — HRC

01798 **Mauger, Richard L.; Diffenbach, Robert.** A sulfur isotope study of Ducktown, Tennessee [abs.]: EOS, v. 51, no. 4, p. 454, 1970.

01593 **McDougall, Donald S.; Osborne, Robert H.** Statistical analysis of calcisiltites from Bird Springs Group, Mountain Springs, Nevada [abs.]: Am. Assoc. Petroleum Geologists Bull., v. 54, no. 3, p. 556, 1970.

01799 **McGetchin, T. R.; Silver, L. T.; Chodos, A. A.** Mineral inclusions in pyropes from Colorado Plateau kimberlite pipes [abs.]: EOS, v. 51, no. 4, p. 448, 1970.

01691 **McIntyre, Andrew.** *Gephyrocapsa protohuxleyi* sp.n., a possible phyletic link and index fossil for the Pleistocene: Deep-Sea Research, v. 17, no. 1, p. 187-190, illus., 1970.

Gephyrocapsa protohuxleyi McIntyre, a new coccolith species from the upper Pleistocene of the Atlantic may be a phyletic link between *Coccolithus huxleyi* and the *Gephyrocapsa* complex. Its stratigraphic range from approximately 0.095 to 1.20 $\times 10^6$ yr B.P. and wide geographic distribution make it potentially useful as an indicator fossil since its last occurrence coincides with the onset of the youngest glacial stage. — Author's abstract

01800 **McKague, H. Lawrence.** Statistical evaluation of petrographic data from the State Line Serpentinite [abs.]: EOS, v. 51, no. 4, p. 450, 1970.

08997 **McKechnie, N. D.** The mineral industry in British Columbia: Canadian Geog. Jour., v. 78, no. 3, p. 76-89, illus., 1969.

The first major breakthrough in mineral development in British Columbia came through placer miners in the 1850's and 1860's. Six key events in mining history are: the discovery of coal at Suquash, Vancouver Island, 1835, of placer gold in the Cariboo in 1858, and of silver-copper ores on Toad Mtn. in 1866; development of the oil-flotation process of ore concentration; completion of the highway from Dawson Creek northwest to Alaska; and development of the Bethlehem open-pit copper mine in Highland Valley southwest of Kamloops. The history of attempts to build smelters is summarized. Geology and production are reviewed for coal, petroleum and natural gas, lead-zinc, copper, molybdenum, iron, silver, gold, miscellaneous metals; and industrial minerals. — ESL

08859 **McKee, Edwin D.; Gutschick, Raymond C.** History of the Redwall Limestone of northern Arizona: Geol. Soc. America Mem. 114, 726 p., illus., tables, 1969.

This is a symposium containing sixteen papers (cited individually). Following the introduction, there are two papers on lithology and stratigraphy; one on general paleontology; one each on Foraminifera, corals, Bryozoa, Brachiopoda, Gastropoda and Pelecypoda, Cephalopoda, Blastoidea, Crinoidea; and one on miscellaneous fossil groups. These are followed by an interpretation of environments, paleogeography, and a final summary of the geologic history. — HRC

08860 **McKee, Edwin D.; Gutschick, Raymond C.** Introduction, Chap. 1 *in* History of the Redwall Limestone of northern Arizona: Geol. Soc. America Mem. 114, p. 1-11, illus., 1969.

This is an introduction to a symposium on the Redwall Limestone. The formation, exposed in the walls of the Grand Canyon and southeastward along Chino Valley and the Mogollon Rim, is 700 feet thick in the Grand Canyon area and thins southeastward to nothing near Snowflake. The formation was first recognized in 1853 by one of the early surveys, and information has accumulated ever since; 137 sections are identified and measured. — HRC

08861 **McKee, Edwin D.; Gutschick, Raymond C.** Sequence of sediments and unconformities, Chap. 2 *in* History of the Redwall Limestone of northern Arizona: Geol. Soc. America Mem. 114, p. 13-95, illus., tables, 1969.

The four members of the Redwall Limestone are, from oldest to youngest: Whitmore Wash, Thunder Springs, Mooney Falls, and Horseshoe Mesa. The Redwall rests unconformably upon rocks of various ages, and is overlain by Middle Pennsylvanian Supai Formation with a considerable disconformity; a karst actually separates the two units. All of the members of the Redwall are present to the west, but hiatuses occur toward the east as a result of two transgressions and regressions. The Redwall contains Chester-aged rocks at one place only and is otherwise Lower and Middle Mississippian in age. — HRC

08862 **McKee, Edwin D.; Gutschick, Raymond C.** Analysis of lithology, Chap. 3 *in* History of the Redwall Limestone of northern Arizona: Geol. Soc. America Mem. 114, p. 97-124, illus., tables, 1969.

Field studies of the Redwall Limestone include detailed descriptions of several different types of limestones, such as granular (peloidal and skeletal, oolitic, and limestone conglomerate), aphanitic limestones, and recrystallized limestone. Dolomite and other magnesium-bearing carbonate rocks are also present, including protodolomite and calcite with magnesium in the structure. Insoluble minerals, forming a minor part of all the rocks, and ferrous iron and manganese contents are discussed. Large-scale cross stratification of the tabular-planar type is common. Replacement bedded chert also is present, especially in the Thunder Springs Member. — HRC

08863 **McKee, Edwin D.; Gutschick, Raymond C.** The Redwall faunas, Chap. 4 *in* History of the Redwall Limestone of northern Arizona: Geol. Soc. America Mem. 114, p. 125-172, illus., 1969.

Collections made at more than 500 stations in the Redwall Limestone include 7 genera and 40 species of foraminifers, 16 genera and 23 species of corals, 30 genera and more than 50 species of brachiopods, 12 genera and 37 species of gastropods, 6 genera and 11 species of pelecypods, 5 genera and 7 species of cephalopods (one ammonoid), 5 genera and 6 species of blastoids, 19 genera and 45 species of crinoids, and 18 genera and more than 23 species of bryozoans; other fossils are rare and scattered. A complete inventory of fauna is given, with genera and species identified for each location. The formation is Kinderhookian to Meramecian, with only one locality containing Chester age fossils. — HRC

08866 **McKee, Edwin D.; Gutschick, Raymond C.** Brachiopods, Chap. 8 *in* History of the Redwall Limestone of northern Arizona: Geol. Soc. America Mem. 114, p. 435-437, 1969.

Nearly 2,000 specimens in 22 genera and 30 species of brachiopods have been collected and are in process of being evaluated; most are of the genus *Spirifer*. The fauna is widespread geographically and includes some from Kinderhookian through Chesterian age rocks. Most are from clastic limestones. — HRC

08870 **McKee, Edwin D.; Gutschick, Raymond C.** Miscellaneous fossil groups — Algae and stromatolites, holothurians, trilobites, ostracodes, and fish, Chap. 13 *in* History of the Redwall Limestone of northern Arizona: Geol. Soc. America Mem. 114, p. 545-552, illus., table, 1969.

These organisms occur very sparingly in the Redwall Limestone. Algae are unusually rare, most being *Calcisphaera*. A few holothurian sclerites have been recovered from insoluble residues, and a few trilobite fragments have been found also. Ostracodes occur in all members of the formation but have not been extensively studied because of the difficulty of extracting them from the limestone and chert. Five species in 4 genera are reported. Scattered fish remains, mostly teeth, are known also, and six species are listed. — HRC

08871 **McKee, Edwin D.; Gutschick, Raymond C.** Paleogeography, Chap. 15 *in* History of the Redwall Limestone of northern Arizona: Geol. Soc. America Mem. 114, p. 571-585, illus., tables, 1969.

The Redwall was deposited upon a shelf, and lapped eastward up and over the low Defiance positive element and over several other submarine ridges. A two-fold transgression and regression is recorded, with erosion before, between, and after the invasions. The Peach Springs and Payson submarine ridges resulted in several basins of accumulation. Comparison of the Redwall with rocks of similar age in the surrounding areas is made. — HRC

08872 **McKee, Edwin D.; Gutschick, Raymond C.** Summary of geologic history — Chronology of events, Chap. 16 *in* History of the Redwall Limestone of northern Arizona: Geol. Soc. America Mem. 114, p. 587-590, 1969.

During the Late Kinderhookian, the Redwall sea advanced over the areas from two or more directions. The shelf was one of low relief, dominated only by the low Defiance positive and two radiating ridges, the Peach Springs and Payson. There was an initial transgression in the Kinderhook and Osage, and this was followed by a regression during the Osage and was then followed by another transgression and then another regression during the Meramec. The Whitmore Wash and Thunder Springs Members represent the first cycle, and the Mooney Falls and Horseshoe Mesa Members the second. There may have been a third transgression and regression, but evidence is very limited. Post-Redwall erosion produced relief up to 40 feet; extensive channels and karst topography can be recognized. — HRC

01629 **McKeown, F. A.; Dickey, D. D.; Bucknam, R. C.** Preliminary analysis of geologic and geodetic data from the JORUM and MILROW nuclear events [abs.]: EOS, v. 51, no. 3, p. 203, 1970.

01656 **McKinney, Thomas F.; Friedman, Gerald M.** Continental shelf sediments of Long Island, New York: Jour. Sed. Petrology, v. 40, no. 1, p. 213-248, illus., tables, 1970.

These shelf sediments can be divided into an inner (0 to 25 fms) and middle (25-35 fms) shelf clean sand facies and an outer (>35 fms) shelf muddy sand facies. Locally on the middle shelf, the outer muddy sand facies is preserved as erosional remnants. This evidence supports the view that the outer muddy sediment is relict; the sharp mud line at about 35 fms results from the winnowing of the formerly more extensive muddy sediment. Using the population concept as well as statistical moment measures of the size distribution, the relict nature of the shelf sediments is interpreted as representing various relict environments. The absence of the B population indicates deposition in the surf zone where intense winnowing occurs. The presence of the C population also suggests deposition in the surf zone. Deposition from currents is indicated by the presence of the B population. — *from* Authors' abstract

01801 **McLaughlin, W. A.; Studer, H. P.** Isotopic ages for various particle size fractions of illitic sediments [abs.]: EOS, v. 51, no. 4, p. 433, 1970.

McNeill, J. D. *See* Barringer, A. R. 09097

09096 **McPherson, R. L.** Industrial minerals potential of the Blairmore Formation: Canadian Ceramic Soc. Jour., v. 38, p. 115-120, illus., tables, 1969.

In northern Saskatchewan the wide-spread Blairmore Formation of Cretaceous age is exposed in prominent cliffs of quartzose sandstone. Large tonnages at three locations are being investigated as a source of industrial silica and kaolin clay. Best known are bank deposits along Red Deer River near Armit, where 20-ft cliffs contain 800,000 tons of sand, about 98 percent pure silica. Deposits south of La Ronge where kaolin is interstitial in Bow River gravels and in 25- to 60-ft cliffs of Blairmore sandstone along the Nipekamew River are more isolated. While the percentage of kaolin known is small, potential tonnage of kaolinized sand and grit is believed to be very large. On the strength of their similarity to deltaic deposits of the Tuscaloosa Formation in Georgia, known to contain lagoonal concentrations of kaolin, these little-known deposits in Saskatchewan deserve to be explored more fully. — GDC

Medaris, L. G., Jr. *See* Cullers, R. L. 01754

01802 **Medaris, L. G., Jr.** Mantle-derived peridotites in southwestern Oregon [abs.]: EOS, v. 51, no. 4, p. 448, 1970.

01688 **Meidav, Tsvi; Rex, R. W.** Geothermal exploration in Imperial Valley [abs.]: Am. Assoc. Petroleum Geologists Bull., v. 54, no. 3, p. 560, 1970.

01803 **Meidav, Tsvi.** Possible sea-floor spreading in the Imperial Valley — [Pt.] 1, Structural setting [abs.]: EOS, v. 51, no. 4, p. 421, 1970.

Meiman, James R. *See* Judy, Clark. 01717

09128 **Meisburger, Edward P.; Duane, David B.** Shallow structural characteristics of Florida Atlantic shelf as revealed by seismic reflection profiles, *in* Geology of the American Mediterranean: Gulf Coast Assoc. Geol. Socs. Trans., v. 19, p. 207-215, illus., 1969.

Results of 2600 mi of seismic reflection profiling off eastern Florida revealed several prominent acoustic reflecting horizons at shallow depth and traceable over large areas of the nearshore continental shelf. These reflectors indicate shallow structural features and can be used for tentative stratigraphic correlation with logged wells onshore. The dominant structural feature is a universal eastward dip of strata; below -100 to -200 broad, low relief undulations of probable structural origin are common. Shallower subbottom strata are characterized by internal bedding feature, erosional surfaces, and gentler eastward dip than deeper section. There is little evidence of faulting with vertical displacement. Acoustic horizons are believed to represent a stratigraphic range from Eocene to Recent with erosional surface and shallow water bedform features reflecting Pleistocene sea-level fluctuations. — VSN

01859 **Melson, W. G.; Thompson, G.** Layered basic complex in oceanic crust, Romanche Fracture, equatorial Atlantic Ocean: Science, v. 168, no. 3933, p. 817-820, illus., tables, 1970.

A layered, basic igneous intrusion, analogous in mineralogy and texture to certain large, continental layered complexes, is exposed in the Romanche Fracture, equatorial Atlantic Ocean. Crustal intrusion of large masses of basic magmas with their subsequent gravity differentiation is probably one of a number of major processes involved in the formation of new oceanic crust during sea-floor spreading. — Authors' abstract

Melson, William G. *See* Simon, Ivan. 01868

Menard, H. W. *See* Atwater, Tanya. 01702

Merewether, E. A. *See* Gill, J. R. 01430

01632 **Merritt, M. L.; Perret, W. R.** Ground shock and water pressures from MILROW [abs.]: EOS, v. 51, no. 3, p. 204, 1970.

01577 **Michalek, Daniel D.** Fanlike features and related periglacial phenomena of the southern Blue Ridge [abs.]: Dissert. Abs. Internat., Sec. B, Sci. and Eng., v. 30, no. 9, p. 4209B, 1970.

08856 **Middleton, Gerard V.** Turbidity currents, Lecture 10 *in* The new concepts of continental margin sedimentation, application to the geological record — AGI short course lecture notes, Philadelphia, 1969: Washington, D. C., Am. Geol. Inst., p. GMA1—GMA20, illus., 1969.

The history of the concept of turbidity currents began with Forel in 1885 and was first applied to geological processes by Daly in 1936. Such a current is defined as a density current in which the difference in density between the current and the ambient fluid (commonly sea water) is due to the presence of dispersed sediment. Various types of flow are described, most coming from flume experiments; they are unique because they are sediment transporting systems which owe their existence to the sediment rather than the fluid. The sedimentary characteristics of the sediments are such that they are difficult to distinguish from deep-sea-current deposits. — HRC

08857 **Middleton, Gerard V.** Grain flows and other mass movements down slopes, Lecture 11 *in* The new concepts of continental margin sedimentation, application to the geological record — AGI short course lecture notes, Philadelphia, 1969: Washington, D. C., Am. Geol. Inst., p. GMB1—GMB14, illus., 1969.

There probably is a continuum from sliding to slumping to formation of a slurry or liquified slump to grain flow with transient excess pore pressures, to true grain flow in the sense of Bagnold. Large-scale, fast-moving grain flows must be turbulent. True grain flows can only be important on very steep slopes, although pore pressures can influence this. Phenomena very similar to grain flow may be produced during deposition from a concentrated "normal" turbulent flow by formation and shearing during the last stages of deposition of an expanded "quick" bed. It would be difficult to distinguished deposits of large-scale grain flow and those deposited by large, highly concentrated turbidity currents. – HRC

Miles, Robert D. *See* Tanguay, Marc G. 09005

01441 **Millard, H. T., Jr.; Finkelman, R. B.** Chemical and mineralogical compositions of cosmic and terrestrial spherules from a marine sediment: Jour. Geophys. Research, v. 75, no. 11, p. 2125-2134, illus., tables, 1970.

Mineralogic and chemical compositions and specific gravities were determined for particles in a collection of large (149-351 μ diameter), dense, magnetic spherules separated from Pacific sediment. They were found to fall into a group of high specific gravity composed of magnetite and, in some cases, wustite and α iron with low Mn, and a group of low specific gravity with high manganese. The concentrations of Ir

and Ni in the spherules of the first group are consistent with an iron meteorite origin, and these are identified as cosmic spherules. The second group is assumed to be terrestrial in origin. Nondestructive measurements were made on individual particles. The requirement that the results of these measurements correlate with one another constitutes a more definitive criterion than those used in the past for establishing extraterrestrial origin of particles. — *from* Authors' abstract

01672 **Millay, Michael A.; Eggert, Donald A.** *Idanothekion* gen. n., a synangiate pollen organ with saccate pollen from the Middle Pennsylvanian of Illinois: Am. Jour. Botany, v. 57, no. 1, p. 50-61, illus., 1970.

This synangiate pollen organ is represented by about 30 specimens in coal balls. *Idanothekion* resembles some synangia assignable to Paleozoic members of the Marattiales; however, the new genus compares most closely with pollen organs believed to have been produced by members of the Pteridospermales. It seems most likely that *Idanothekion* represents the pollen organ of some member of the Lyginopteridaceae that produced pollen of a type which up to now has not been known from Paleozoic seed ferns. — *from* Authors' abstract

Miller, Donald S. *See* Lakatos, Stephen. 01791

09026 **Miller, Pat H.; Coale, Burton V.** Colorado National Monument — A fantastic landscape sculptured by erosion: [Fruita, Colo.] Colorado and Black Canyon of the Gunnison Nature Assoc., 73 p., illus., 1969.

Vividly colored cliffs and monoliths carved from the northern edge of the Uncompahgre Plateau, in west-central Colorado, tower 1,500 feet above the Grand Valley of the Colorado River. Briefly reviewed are geomorphic processes in uplift begun in Pennsylvanian time, erosion of the ancient highland down to the Precambrian core now exposed on canyon floors, and deposition of the various Mesozoic formations seen in the canyon walls and mesas; the change from desert to sea conditions, late Cretaceous subsidence, and deposition of Tertiary formations of the surrounding high plateau. Erosional properties of the rocks are related to their composition and sedimentary structures. Pliocene basalt lava flows which cap the high plateau to the east are absent here. Triassic conditions were not conducive to the preservation of Triassic life; Jurassic dinosaur remains, collected nearby in the Morrison Formation, are listed. — GDC

Miller, Robert C. *See* Rainey, Henry C., 3d. 08914

Milo, Dean. *See* Hays, James D. 01429

01727 **Mining in Canada.** Performance of the mineral industry in 1969, with a look to the future: Mining in Canada, February 1970, p. 37-81, illus., tables, 1970.

The production development, and outlook of the mineral industry as a whole in 1969 is summarized for the following areas: Canada (as a whole), Newfoundland, Nova Scotia, New Brunswick, Quebec, Ontario, Manitoba, Saskatchewan, Alberta, Prince Edward Island, British Columbia, Northwest Territories, and Yukon Territory. Production, development, and outlook are then summarized for: copper, iron ore, nickel, zinc, lead, gold, silver, uranium, molybdenum, fluorspar, nepheline, syenite, potash, asbestos, sulfur, fuels, and gypsum. — GV

01642 **Miyashiro, Akiho; Shido, Fumiko; Ewing, Maurice.** Petrologic models for the Mid-Atlantic Ridge: Deep-Sea Research, v. 17, no. 1, p. 109-123, illus., table, 1970.

Serpentinites and metabasites occur with unmetamorphosed basalts in transverse fracture zones across the Mid-Atlantic Ridge. Serpentinites appear to have formed by hydration of upper mantle peridotite. Two petrologic models have been formulated for the Ridge. In the first, anomalous upper mantle with low seismic velocity beneath the Ridge and the main layer of oceanic crust are considered to be mainly serpentinites with metabasite masses; serpentinite-metabasite complexes appear to be covered by a thin layer of basaltic volcanic rocks. In the second, serpentinites in

fracture zones are being formed by hydration of peridotites intruded into the zones; the main part of the crust is assumed to be metabasites, covered by a thin layer of basaltic volcanic rocks. The anomalous upper mantle is partly plagioclase peridotite and partly fractured amphibole peridotite. The second model is in better harmony with existing data. — *from* Authors' abstract

01504 **Moench, Robert H.** Premetamorphic down-to-basin faulting, folding, and tectonic dewatering, Rangeley area, western Maine: Geol. Soc. America Bull., v. 81, no. 5, p. 1463-1496, illus., table, 1970.

The dominant structural pattern of Ordovician, Silurian, and Devonian rocks is defined by tight, upright, northeast-trending passive flow folds and by three major normal faults along which younger rocks on the southeast are down-faulted against older rocks on the northwest. Slaty or phyllitic cleavage of this deformation is typically subparallel to the axial surfaces of folds. Deformation evolved as follows: (1) rapid deposition of 15,000 to 20,000 ft of nearly impermeable clastic sediments in Late Ordovician and Early Silurian time; (2) continuing sedimentation, down-to-basin creep with associated slump faulting and folding; (3) horizontal compression developed parallel to slide direction and cleavage normal to compression; and (4) pore fluids expelled vertically, permitting the slumping mass to compact and fold. — AH

09098 **Monahan, Charles J.** Reservoirs in volcanic terrain, *in* Reservoir leakage and groundwater control: Assoc. Eng. Geologists Bull., v. 6, no. 1, p. 53-60, table, 1969.

Investigations of sites for reservoirs in volcanic terrane differ from those for any other reservoir site only in the geologic concepts to be applied. Premises for reservoirs in volcanic areas are developed for the Columbia Basin of the Pacific Northwest, a generally arid area. Studies indicate that volcanic strata are highly anisotropic with respect to permeability. By using a general knowledge of the permeability characteristics of volcanic strata and an adequate geologic knowledge of the reservoir area, it is possible to predict leakage from a reservoir qualitatively and quantitatively. Leakage is generally of low magnitude and not critical as is shown by reservoirs now in existence. Because some reservoirs have proved inadequate due to leakage and because future needs will require use of less favorable sites, continued vigilance and development of techniques are warranted. — *from* Author's abstract

09099 **Moneymaker, Berlen C.** Reservoir leakage in limestone terrain, *in* Reservoir leakage and groundwater control: Assoc. Eng. Geologists Bull., v. 6, no. 1, p. 3-30, illus., 1969.

Limestone terranes may present difficult and costly problems in constructing watertight reservoirs, as bedding planes, joints, solution cavities and other open structures serve as leakage paths. Solution channels may occur along reservoir rims or far below stream beds. In Tennessee, at Hales Bar and Great Falls reservoirs, completed in 1913 and 1925, respectively, immediately after impoundment copious leakage developed along solution cavities, and accelerating rapidly as flowing water under hydrostatic head, removed clay, silt, or sand from filled or partially filled cavities. Leakage from the Hales Bar reservoir occurred through subriver cavities beneath the dam. Two sizable zones of solutional spongework developed in fault zones. At Great Falls, leakage was through the rim along tabular cavities developed along bedding planes. — *from* Author's abstract

01513 **Monroe, Watson H.** (compiler). A glossary of karst terminology: U.S. Geol. Survey Water-Supply Paper 1899-K, p. K1-K26, 1970.

This glossary includes most terms used in describing karst geomorphologic features and processes. The terms are primarily those used in the literature of English-speaking countries, but a few of the more common terms in French, German, and Spanish are included, with references to the corresponding English terms where they are available. The glossary also includes simple definitions of the more common rocks and minerals found in karst terrain, common terms of hydrology, and a number of the descriptive terms used by speleologists. The glossary does not include definitions of

carbonate rock that require microscopic techniques for identification, or names describing tools and techniques of cave exploration. — Author's abstract

09023 **Montgomery, Arthur.** The mineralogy of Pennsylvania, 1922-1965 — Supplementing and updating Gordon's "The mineralogy of Pennsylvania (1922)": Acad. Nat. Sci. Philadelphia Spec. Pub. 9, 104 p., illus., tables, 1969.

Revision and updating of Samuel G. Gordon's "The mineralogy of Pennsylvania" (1922) was begun by the Mineralogical Society of Pennsylvania in 1962 with publication of a monthly column, *Pennsylvania Minerals*, in their Keystone Newsletter. The present volume incorporates material from that column, using and bringing up to date only the more significant data bearing on mineral discoveries, occurrences and origin, and covering the period of its publication. Reliance has been placed on mineral collectors, especially of the Society, for much of the new data. Included are a revised list of Pennsylvania minerals, descriptive mineralogy of newly recorded species, new data on earlier recorded minerals grouped into those of historical and geochemical interest, and zeolites and related secondary minerals. Mineral names and localities are listed in the index. — GDC

01636 **Montigny, Raymond; Javoy, Marc; Allègre, Claude J.** Le problème des andésites — Étude du volcanisme quaternaire du Costa Rica (Amérique centrale) à l'aide des traceurs couples Sr-87/Sr-86 et O-18/O-16 [abs.]: Soc. Géol. France Compte Rendu 1969, pt. 8, p. 287, 1970.

01547 **Moore, Bruce R.** Scour and fill processes in a deep river hole, Ohio River, Louisville, Kentucky: Jour. Sed. Petrology, v. 40, no. 1, p. 449-462, illus., 1970.

A deep hole produced in the Ohio River by suction dredging was measured over a period of two years before and after high water periods. The hole did not fill, but scoured slightly deeper after each high water and the walls remained almost vertical. A vortex or circular eddy developed in the surface flow during high water and sediment was removed from the hole and deposited between the hole and the bank. The movement of water and sediment in the model hole in a flume indicated that a vortex mechanism involving a balance of scour and fill is keeping the hole free of sediment during each period of flood. The sequence of sedimentary structures for the model hole included foreset type beds and dune bedding migrating both upstream and downstream. The final structures preserved depend upon the relative lengths of the phases of scour and fill and the maximum mean velocity of the stream. — Author's abstract

08909 **Moore, Donald B.; Joiner, Thomas J.** A subsurface study of southeast Alabama: Alabama Geol. Survey Bull. 88, 33 p., illus., tables, 1969.

A subsurface study of 13 counties in southeastern Alabama to evaluate water, mineral, and petroleum resources was based on available data from oil-test wells, core holes, and water wells. The easternmost limit of the salt basin extends through Escambia County. Most geologic structures detected in the Lower Cretaceous Series or in younger sediments in the salt basin are the result of movement of underlying Jurassic Louann Salt; east of the basin, influence of basement tectonics is of primary importance in evaluating structure. Subtle structural indications and numerous facies changes offer possibilities as potential oil traps. The Pollard oil field proves the existence of source and reservoir beds in Escambia County; Covington and Conecuh Counties have good oil and gas potential. Test wells drilled in other parts offer little encouragement for petroleum possibilities, but most of the area remains virtually untested. — *from* Authors' abstract

Moore, J. R. M. *See* Moore, L. R. 08946

08946 **Moore, L. R.; Moore, J. R. M.; Spinner, E.** A geomicrobiological study of the Pre-Cambrian Nonesuch Shale: Yorkshire Geol. Soc. Proc., v. 37, pt. 3, p. 351-394, illus., tables, 1969.

The Keweenawan Nonesuch Shale is part of the copper belt in Ontonagon County, Mich. The amorphous groundmass of the well-preserved organic content consists of saprophytic microbiologic degradation products, with attacking microorganisms often in situ. The total organic content represents an ecosystem. Mattes of tissue composed of larger fungi are oriented with bedding on the organic-rich elements of paired, laminated, or varved deposits. This organic degradation is at least a thousand million years old, and suggests that physico-chemical-biologic conditions and related environmental parameters were comparable over this time. The paper supports sedimentologic conclusions of White and Wright (1954), but deduces a tidal lagoon or mud flat. The organic assemblage, biologic process of degradation, and characteristics of the environment are compared with geologic and recent examples of tidal lagoons and mud flats. — *from* Authors' abstract

09048 **Moore, Paul B.; Louisnathan, S. John.** The crystal structure of fresnoite, $Ba_2(TiO)Si_2O_7$ [with German abs.]: Zeitschr. Kristallographie, v. 130, nos. 4-6, p. 438-448, illus., tables, 1969.

The structure of fresnoite, $Ba_2(TiO)Si_2O_7$, was determined from the Patterson projection $P(uv)$ and refined by the least-squares method using three-dimensional single-crystal data. Its unique feature is the tetragonal-pyramidal coordination of titanium. Sheets made up of heterocyclic five-membered rings of Ti-O tetragonal pyramids and Si-O tetrahedra are held together by Ba-O bonds. The bonds within the sheet are predominantly covalent, and the intersheet bonds are mainly ionic in character. — Authors' abstract

01408 **Moore, Raymond C.** Stability of the Earth's crust: Geol. Soc. America Bull., v. 81, no. 5, p. 1285-1323, illus., 1970.

The author emphasizes the stability of the crust of North America by applying the evidence from stratigraphic and historical geology. With the aid of structure sections and "Schuchertian" paleogeographic maps, the shield and cratonic areas of the continent are shown as subject to periods of submergence and emergence but relatively free of other deformation for long periods of time. — RGY

Moore, W. Richard. *See* Davies, David K. 01541

09072 **Morehouse, David F.** Precise stratigraphic control of solutional activity in the Galena Formation, Upper Mississippi Valley [abs.]: Natl. Speleol. Soc. Bull., v. 31, no. 2, p. 40, 1969.

09076 **Morehouse, David F.** Speleogenetic type-examples in eastern Iowa [abs.]: Natl. Speleol. Soc. Bull., v. 31, no. 2, p. 42, 1969.

09087 **Morel-Seytoux, H. J.** Introduction to flow of immiscible liquids in porous media, Chap. 11 *in* Flow through porous media (R. J. M. DeWiest, editor): New York and London, Academic Press, p. 455-516, illus., 1969.

Understanding of simultaneous flow of immiscible fluids in a porous medium is prerequisite to sound operations in production of oil and natural gas. In this paper techniques are stressed, assuming a more mathematical than physical point of view. In contrast to the single-phase problems of water, oil seldom occurs alone and may liberate gas as reservoir pressure decreases. As in hydraulic seepage or salt-water intrusion, a sharp interface between fluids may be assumed. In production, with loss of discovery pressure, oil must first be pumped, then another fluid injected to drive it out. Following basic definitions and concepts of flow, microscopic models are compared with macroscopic observations. Equations are derived for experimental study of a simple case of two-phase flow in a strictly linear medium. — GDC

01860 **Morimoto, Nobuo; Nakazawa, Hiromoto; Nishiguchi, Katsuhisa; Tokonami, Masayasu.** Pyrrhotites — Stoichiometric compounds with composition $Fe_{n-1}S_n$ ($n > 8$): Science, v. 168, no. 3934, p. 964-966, illus., table, 1970.

A new type of natural pyrrhotite, orthorhombic 11C type (a = 6.892, b = 11.952, c = 5.744 × 11 angstroms), and the hexagonal 6C type (a = 6.89, c = 5.76 × 6 angstroms) are described. Their compositions are $Fe_{10}S_{11}$ and $Fe_{11}S_{12}$, respectively. Pyrrhotites stable in nature have essentially stoichiometric composition, $Fe_{n-1}S_n$ ($n > 8$), with the structures of n/2C type for n even and of nC type for n odd. The solid solutions between $Fe_{11}S_{12}$ and $Fe_{10}S_{11}$, and between $Fe_{10}S_{11}$ and Fe_9S_{10} are considered metastable in nature. — Authors' abstract

01599 **Morin, Ronald W.** Late Quaternary biostratigraphy of cores from beneath California Current [abs.]: Am. Assoc. Petroleum Geologists Bull., v. 54, no. 3, p. 559, 1970.

01582 **Morris, Gerald Brooks.** Velocity anisotropy and crustal structure of the Hawaiian arch [abs.]: Dissert. Abs. Internat., Sec. B, Sci. and Eng., v. 30, no. 9, p. 4212B, 1970.

01557 **Mountjoy, Wayne.** Determination of cobalt in geologic materials by solvent extraction and atomic absorption spectrometry, *in* Geological Survey research 1970, Chap. B: U.S. Geol. Survey Prof. Paper 700-B, p. B174-B176, tables, 1970.

Cobalt content in geologic materials can be accurately and rapidly determined by use of a new solvent extraction-atomic absorption analytical method. In this method the cobalt is concentrated and separated from interfering elements by extracting the 2-nitroso-1-naphthol chelate of cobalt into methyl isobutyl ketone. A lower limit of 2 ppm in a 1-g sample is readily attained. Analyses of seven reference samples confirmed the accuracy of the method. — Author's abstract

01486 **Mower, R. W.** Ground-water inflow toward Jordan Valley from Utah Valley through valley fill near the Jordan Narrows, Utah, *in* Geological Survey research 1970, Chap. B: U.S. Geol. Survey Prof. Paper 700-B, p. B199-B202, illus., 1970.

About 2,500 acre-feet of ground water annually is moving generally northward from Utah Valley toward Jordan Valley through unconsolidated valley fill near the Jordan Narrows, Utah. The computation of underflow was made at a section in which the saturated fill averages about 125 feet in thickness and is between 2,700 and 4,000 feet wide. The fill consists of sediments ranging from clay to coarse gravel in size, and it has an average hydraulic conductivity of about 3,200 cubic feet per day per square foot. Underlying and bounding the fill on the east and west sides of the narrows are semiconsolidated or consolidated rocks of low average hydraulic conductivity through which there is little underflow. — Author's abstract

08977 **Muan, A.; Osborn, E. F.** Studies of phase equilibria in the systems CaO-MgO-Al_2O_3-SiO_2 and CaO-MgO-Al_2O_3-TiO_2-SiO_2 — Pt. 3, Addendum note to part 2 occasioned by papers of E. D. deWys and W. R. Foster on the system diopside-anorthite-akermanite: Pennsylvania State Univ. Coll. Earth and Mineral Sci. Expt. Sta. Bull. 85, p. 53-58, tables, 1969.

The findings of deWys and Foster (1956; 1958) and deWys (1960) alleging that the system Ak-An is binary and the system Ak-An-Di is ternary with eutectic at 1226° is judged to be erroneous on the basis of the work of Gee and Osborn (ibid., p. 23-51). This conclusion is demonstrated by results given in this note of study of several mixtures. — VSN

01413 **Mudie, J. D.; Normark, W. R.; Cray, E. J., Jr.** Direct mapping of the sea floor using side-scanning sonar and transponder navigation: Geol. Soc. America Bull., v. 81, no. 5, p. 1547-1553, illus., 1970.

The side-scanning sonar, precision bathymetry, and acoustic transponder navigation capabilities of the Marine Physical Laboratory deep-tow device were used to produce a bathymetric chart, a pictographic map of side-scanning sonar data, and a photographic mosaic of the side-scanning sonar records corrected for lateral distortion for a 5 x 6-km section of the La Jolla deep-sea fan. The precise navigation provided by the acoustic transponder system made possible a detailed description of the meanders of the La Jolla Fan-Valley and recognition of subtle depressions and lineaments on the open fan. — Author's abstract

01804 **Muehlenbachs, Karlis; Clayton, Robert N.** O-18/O-16 studies of fresh and weathered submarine basalts [abs.]: EOS, v. 51, no. 4, p. 444, 1970.

Muffler, L. J. P. *See* White, Donald E. 01850

01695 **Murata, K. J.** Tholeiitic basalt magmatism of Kilauea and Mauna Loa volcanoes of Hawaii: Naturwissenschaften, v. 57, no. 3, p. 108-113, illus., tables, 1970.

The primitive magmas of Kilauea and Mauna Loa are generated by partial melting of mantle peridotite at depths of 600 km or more. The primitive melt must contain at least 20 percent MgO in order to have olivine as liquidus material. The only substance lost during rather rapid ascent to the surface is olivine. Although roughly similar, historic lavas of the two volcanoes show a consistent difference in composition; the primitive melt of Mauna Loa contains 20 percent more dissolved orthopyroxene, a high-temperature melting phase in the mantle, and is deficient in K, U, and Nb which presumably occur in minor low-melting phases. Mauna Loa appears to be the older volcano, deriving its magma at higher temperatures and greater depth from a more depleted source rock. — DBV

Murphy, Andrew. *See* Savino, John. 01633

Murri, William J. *See* Petersen, Carl F. 01446

08964 **Nabarro, F. R.** Steady-state diffusional creep [abs.], *in* The application of modern physics to the earth and planetary interiors (S. K. Runcorn, editor): London and New York, Wiley-Interscience, p. 251, 1969.

Nakazawa, Hiromoto. *See* Morimoto, Nobuo. 01860

08951 **Nalivkin, V. D.; Gostintsev, K. K.; Grossgeym, V. A.** O tipakh krupnykh platformennykh struktur SShA [On the types of large platform structures of the U.S.A.]: Geotektonika 1969, no. 6, p. 3-15, illus., tables, 1969.

The tectonic scheme of the platform part of the United States is plotted on the basis of the 1:2,500,000-scale tectonic map of the United States, together with other published data. Five different types of tectonic regions are distinguished — the southern part of the ancient Canadian shield, the epi-Proterozoic North American plate, the Hercynian folded region, the Rocky Mountain region of epi-platform orogenesis, and the Cordilleran Meso-Cenozoic geosynclinal system. The platform structures of the United States are compared with those of the U.S.S.R. There are definite analogies, and the greater amount of drilling on most of the oil and gas districts of the United States facilitates the assessment of the oil and gas prospects of the major structures in the U.S.S.R. — DBV

01805 **Nason, Robert D.** Geodetic measurements and fault slip in central California [abs.]: EOS, v. 51, no. 4, p. 427, 1970.

09029 **National Research Council.** (Committee on Seismology). Seismology, responsibilities and requirements of a growing science — Pt. 1, Summary and recommendations; Pt. 2, Problems and prospects: Washington, D.C., Natl. Acad. Sci., Pt. 1, 38 p., illus., table; Pt. 2, 59 p., illus., 1969.

With the end of the International Geophysical Year and the Upper Mantle Project in the United States, a critical assessment of the science of seismology is essential to take advantage of the hard core of seismologic manpower and great advances in equipment and technology, and also to satisfy the needs of the nation on earthquake research, the search for oil and minerals, and an understanding of earth structure and tectonic processes as a base for exploitation of resources and use of the environment. Part 1, which summarizes essential background information and lists major recommendations and comments, is intended for use of those for whom a concise version, emphasizing only essentials, may be of special value. Part 2, which reviews the history of seismology, discusses research and provides insights into further research, is intended for use of planners, administrators, educators, and students. — MCM

Neale, E. R. W. *See* Williams, Harold. 01505

01601 **Neidell, N. S.** Semblance and other coherency measures for multichannel data [abs.]: Am. Assoc. Petroleum Geologists Bull., v. 54, no. 3, p. 560, 1970.

01708 **Neill, Charles R.** Formation of flood plain lands — Discussion [of paper 6574 by W. C. Carey, 1969]: Am. Soc. Civil Engineers Proc., v. 96, Jour. Hydraulics Div., no. HY 1, p. 297-298, illus., 1970.

Carey (ibid., v. 95, no. HY 3, p. 981-984, 1969) has presented a useful summary of alluvial land-forming processes, but Neill raises a query concerning the statement that "it is normal for alluvial river features to migrate downstream." An example is shown where the shift process seems to consist of lateral enlargement of loops, sometimes referred to as "free meandering." Downstream migration seems to be associated with alluvial fills in narrow valleys, whereas free meandering tends to occur in broad flats. — ESL

01716 **Nelson, Jack L.; Haushild, W. L.** Accumulation of radionuclides in bed sediments of the Columbia River between Hanford reactors and McNary Dam: Water Resources Research, v. 6, no. 1, p. 130-137, illus., tables, 1970.

Amounts of radionuclides from the Hanford reactors in river bed sediments were estimated from data on radionuclide concentration for the bed sediments between the reactors and McNary Dam; and from data on radionuclide discharge for river stations at Pasco, Wash., and Umatilla, Oreg., 3.2 km below the dam. Accumulations in the Pasco to Umatilla reach estimated by the two methods agree within 8 percent. In October 1965 approximately 16,000 curies of gamma-emitting radionuclides were resident in the bed sediments between reactors and dam. Concentrations of chromium-51, zinc-65, cobalt-60, manganese-54, and scandium-46 generally are higher near the dam, due to an increase downstream from the reactors in the proportion of fine-grained sediment and proportions of transported zinc, cobalt, manganese, and scandium radionuclides associated with sediment particles. — *from* Authors' abstract

01806 **Nelson, T. H.; Roeder, D. H.** Post-Paleozoic evolution of the northern Pacific Ocean [abs.]: EOS, v. 51, no. 4, p. 421, 1970.

01538 **Neumann, A. Conrad; Gebelein, Conrad D.; Scoffin, Terence P.** The composition, structure, and erodability of subtidal mats, Abaco, Bahamas: Jour. Sed. Petrology, v. 40, no. 1, p. 274-297, illus., tables, 1970.

The composition and microstructure of widespread subtidal biological mats binding sandy carbonate sediments in the Rock Harbour Cays were examined in detail. Three basic mat types were recognized: a fibrous, rigid, *Cladophoropsis* mat; a thin, gelatinous, *Lyngbya* mat; a cohesive, aggregated *Schizothrix* mat. Erosion tests *in situ* and in the laboratory flumes were made. The natural, *in situ*, mat-bound sediment could withstand current velocities at least twice as high and in some cases, as much as five times as high as those that eroded the treated, unbound sediment. This study demonstrates the need for close consideration of interfacial biological communities when examining depositional and erosional processes at the sediment-water interface, or when making interpretations from the products of these processes in ancient rocks. — *from* Authors' abstract

Niazi, Mansour. *See* Bolt, Bruce A. 01679

08960 **Niblett, E. R.; Witham, K.; Caner, B.** Electrical conductivity anomalies in the mantle and crust in Canada, *in* The application of modern physics to the earth and planetary interiors (S. K. Runcorn, editor): London and New York, Wiley-Interscience, p. 155-172, illus., 1969.

Investigations on the three prominent magnetic variation anomalies found in Canada are reviewed. Main features of the anomaly at Alert on northern Ellesmere Island probably reflect a massive highly conducting body in the lower crust, several hundred km long and 100 km in cross section. The anomaly at Mould Bay on Prince Patrick Island is characterized on magnetograms by absence of shorter-period fluctuations in the vertical component; a subterranean conductor, possibly a horizontal slab a few hundred km in extent, is postulated. Supporting seismic observations suggest an

anomalous structure deep in the crust or upper mantle. East-west profiles across the Cordillera in southern British Columbia and in the United States indicate that the western part may be characterized by small vertical force variations and low seismic P_n velocities while the eastern and plains areas have higher values, suggesting different physical properties of the deep crust or upper mantle under the two areas. — VSN

08901 **Nicholson, F. H.; Nicholson, H. Margaret.** A new method of measuring soil carbon dioxide for limestone solution studies, with results from Jamaica and the United Kingdom, *in* Limestone geomorphology, a study in Jamaica: Cave Sci., v. 6, nos. 43-44, p. 126-148, illus., tables, 1969.

The new method, based on slow diffusion of soil air through a polythene membrane, before analyzing in Haldane gas analyzer, appears to be useful in studies of soil carbon dioxide in relation to limestone solution, and may have wider applications. Concentrations of 0.6 to 1.9 percent carbon dioxide were found in soils over limestone in Jamaica, and of 0.3 percent in soil over limestone in Britain during the winter season. In general tropical soils seem to contain higher concentrations than temperate. Thus, percolation water in the tropics is likely to be capable of more solution of limestone than that in temperate regions. Many techniques are available for study of different parts of the limestone solution budget; it should be possible to assess quantitatively the relative importance of many aspects of the budget. — GDC

Nicholson, H. Margaret. *See* Nicholson, F. H. 08901

08934 **Nielsen, Niels.** Morphological studies on the eastern coast of Disko, West Greenland [with Danish summ.]: Geog. Tidsskr., v. 68, pt. 1, p. 1-35, illus., table, 1969.

This description of a low coast on Disko is based on detailed mapping of an offshore barrier system with lagoon and salt marsh areas. Results are reported of preliminary investigations and measurements of tide, currents, and beach drift and an analysis of the vegetation; some comments are made on the influence of ice on such a coast. Further mapping must be extended to nearshore parts of the beach plane, from the already-mapped area up to and including the distal part of the barrier, for a satisfactory explanation of the development of a coast of this type. The littoral stretch from Nukelv to the Mudderbugt-delta is ideal for material drift and sedimentation budget in the closed basin between barrier and mainland. In the salt marsh area, sample plots have been marked for measurements after a few years, and there is a tidal inlet, the development of which might change the nearshore zone fundamentally. — GDC

09056 **Nielson, F. Dwayne; Bhandhausavee, Choosin; Yeh, Ko-Shing.** Determination of modulus of soil reaction from standard soil tests: Highway Research Rec. 284 (Natl. Acad. Sci. Pub. 1661), p. 1-12, illus., tables, 1969.

The theory of elasticity was used to determine the relation between the modulus of soil reaction and results of the California Bearing Ratio test, Hveem's stabilometer test, and standard soil properties such as density, compaction, moisture content, and plasticity index, using an empirical correlation presented by the California Division of Highways between the R-value and the plate-bearing test. With slight empirical adjustments, laboratory results indicate a satisfactory correlation for most design of flexible pipe for underground conduits. For small installations, where such laboratory tests are not feasible, approximate value for the modulus of soil reaction can be obtained from a simple compaction test. — *from* Authors' abstract

09126 **Nilsen, T. H.** The Army Topographic Command gravity program in the western United States, *in* Symposium on gravity surveys in western North America (David F. Barnes, editor): EOS, v. 50, no. 10, p. 528-529, 1969.

The activities of the Gravity Division of the Department of Geodesy of the Army Topographic Command since 1965 are described. Four types of gravity surveys have been completed: state base station networks, regional gravity surveys, coastal and lake-bottom gravity surveys, and special surveys, such as earth-tide studies and gravity measurements conducted in Arizona. Data reduction and interpretation are discussed. — GV

Nishiguchi, Katsuhisa. *See* Morimoto, Nobuo. 01860

Noble, Donald C. *See* Rogers, C. L. 08913

Normark, W. R. *See* Mudie, J. D. 01413

01438 **Norris, Roger A.; Hart, David N.** Confirmation of sofar-hydrophone detection of submarine eruptions: Jour. Geophys. Research, v. 75, no. 11, p. 2144-2147, illus., 1970.

This paper updates the one by Norris and Johnson (ibid., v. 74, no. 2, p. 650-664, 1969) in which five sources of underwater sound having volcanic characteristics, and located by means of the Pacific Missile Range Sofar-hydrophone network, were described. In 1969, an acoustic pattern similar to those already discussed was observed on paper recordings of the sofar hydrophones at Midway, Wake and Eniwetok which seems to confirm the earlier observations. — GV

Novitzki, R. P. *See* VanVoast, W. A. 01531

01558 **Nowlan, Gary A.** A field method for the determination of cold-extractable nickel in stream sediments and soils, *in* Geological Survey research 1970, Chap. B: U.S. Geol. Survey Prof. Paper 700-B, p. B177-B180, 1970.

Readily extractable nickel is leached from the sample by brief treatment with 4N nitric acid. Addition of ammonium citrate-ammonium hydroxide-sodium hydroxide buffer adjusts the pH to about 10. Thiosulfate ion in the buffer minimizes possible copper interference. Nickel is extracted and estimated by adding α-furildioxime dissolved in benzene, shaking to concentrate the yellow complex in the benzene, and comparing visually with standards. A concentration range of 0.25 to 60 ppm is achieved when a 0.2-g sample is used. An analysis may be done in 3 minutes or less and requires only simple equipment, making sample-site determinations possible. — Author's abstract

01807 **Nunes, Paul D.** U-Pb age determinations of the Stillwater igneous complex and associated rocks [abs.]: EOS, v. 51, no. 4, p. 449, 1970.

Nur, Amos. *See* Horai, Ki-iti. 01447

09057 **Obrcian, Vladimir.** Determination of lateral pressures associated with consolidation of granular soils: Highway Research Rec. 284 (Natl. Acad. Sci. Pub. 1661), p. 13-22, illus.; closure to discussion, p. 25, 1969.

A consolidation apparatus permits gradual load application at a desired rate while vertical and lateral stresses are simultaneously observed under condition of no lateral yielding. Friction loads inherent in normal consolidation testing were observed also, their magnitude reported higher for loose and finer grain soils than for the dense and coarser ones. Four granular soil specimens, tested in loose, medium compact and compact states, demonstrate that the coefficient of earth pressure at rest is less for the dense than for the loose state, and decreases with higher consolidation stress levels; influence of gradation is less pronounced. Simulated stress history studies demonstrated the residual stress phenomenon associated with soils subjected to unloading and reloading cycles. — GDC

01808 **O'Connell, Richard J.; Wasserburg, G. J.** Effect of a phase boundary on subsidence and uplift from sedimentation or erosion [abs.]: EOS, v. 51, no. 4, p. 431, 1970.

01435 **Ogata, Akio.** Theory of dispersion in a granular medium: U.S. Geol. Survey Prof. Paper 411-I, p. I1-I34, illus., 1970.

This report is a presentation of the theoretical aspects of the investigations and a few confirmatory laboratory studies of the dispersion process. The basic assumptions associated with the development of the dispersion equation, based on the applicability of a heuristic expression similar to Fick's law, are described. In general, these assumptions limit its application to a homogeneous medium in which the dispersion

process is anisotropic. The present level of knowledge is made apparent through the presentation of several solutions for the differential equation that approximates the dispersion process. Adsorption and its effect on the fate of a contaminant is given only limited discussion because of the lack of formal studies, on a macroscopic scale, applicable to the hydrologic regimen. The equations approximating dispersion in a two-fold system (salt-fresh water) are also presented. — Author's abstract

01481 **Oldale, R. N.; Uchupi, Elazar.** The glaciated shelf off northeastern United States, *in* Geological Survey research 1970, Chap. B: U.S. Geol. Survey Prof. Paper 700-B, p. B167-B173, illus., 1970.

The Continental Shelf off northeastern United States is made up of basins flanked on the landward side by the Fall Zone and on the seaward side by a cuesta. Morphology of the shelf is believed to be the result of fluvial erosion during pre-Late Cretaceous, Paleocene, and Pliocene-early Pleistocene time, and glacial erosion during the Pleistocene. Bathymetry of the shelf and topography of the basement show a drainage system developed during late Tertiary-early Pleistocene and modified by glacial erosion during the Pleistocene. Older erosion surfaces may have controlled the late Tertiary-early Pleistocene fluvial erosion. Folded sedimentary rocks below fluvially carved thalwegs in the Gulf of Maine indicate structural basins, probably Triassic or Carboniferous. Seismic velocities of folded sedimentary rocks suggest that basins may be as young as Tertiary. — *from* Authors' abstract

Oldenburg, D. W. *See* Porath, H. 01680

08911 **Ollier, Cliff.** Volcanoes: Cambridge, Mass., and London, England, MIT Press (Introduction to Systematic Geomorphology, V. 6), 177 p., illus., 1969.

This account of volcanoes, their activity, and especially their landforms is written for high school and university students, and general readers interested in volcanoes and scenery. Although the chapters are interrelated, it is not necessary to read them in sequence; most of chapter 1 and parts of several others may be used mainly for reference. Chapter headings are: volcanic rocks, volcanic eruptions, types of volcano, craters and calderas, lava flows, pyroclastic fall deposits, pyroclastic flow deposits, intrusive igneous rocks, hydrology and drainage of volcanic areas, weathering and erosion, patterns of volcanic distribution, and aspects of vulcanology. A bibliography and subject index are appended. — MCM

01657 **Opdyke, N. D.** Preliminary report on paleomagnetism of Deep Sea Drilling Project Leg 2 specimens, [Chap.] 17 *in* Initial reports of the Deep Sea Drilling Project — V. 2, Leg 2 of cruises of *Glomar Challenger*, Hoboken, N. J., to Dakar, Senegal, Oct.-Nov. 1968: Washington, D. C., U.S. Govt. Printing Office, p. 375-385, illus., tables, 1970.

The intensity of magnetization varies widely both within each site and between sites, from about 1×10^{-7} to 2×10^{-4} emu/gram. A.F. demagnetization curves are typical of stable and partially stable rocks. Magnetic inclination is plotted. Most of the specimens are older than Miocene, so that comparison with known magnetic stratigraphy for the past 5 m.y. or with sea-floor spreading is probably unwarranted; however, dominantly normal or reversed magnetization is found in sections of core as old as Eocene and Upper Cretaceous. — ESL

09031 **Opdyke, N. D.** The Jaramillo event as detected in oceanic cores, *in* The application of modern physics to the earth and planetary interiors (S. K. Runcorn, editor): London and New York, Wiley-Interscience, p. 549-552, illus., table, 1969.

The purpose of this study is to better define the length of time during the Jaramillo normal polarity event (upper Matuyama reversed epoch), and to determine the time of its lower and upper boundaries. Fifteen oceanic sediment cores which pass through the Jaramillo event were used in the study. Using Cox and Dalrymple's age of 700,000 yr for the beginning of the Matuyama epoch and curves of sedimentation rate, it is shown that the Jaramillo event in all cores falls between 786,000 and 1,125,000 yr. To determine the most probable interval of time and that for its

beginning and end, averages were computed using cores in which sedimentation rate exceeded 5 mm per 1,000 yr. The average age of the end of the event is 870,500 yr with standard deviation of 32,560 yr; average age for the beginning is 926,500 yr. Comparisons are made with K-Ar ages of lava flows; agreement is reasonable in view of the uncertainties of both techniques. — VSN

Orange, A. S. *See* Vozoff, K. 08877

08971 **O'Reilly, W.** Application of neutron diffraction and Mössbauer studies to rock magnetism, *in* The application of modern physics to the earth and planetary interiors (S. K. Runcorn, editor): London and New York, Wiley-Interscience, p. 479-484, illus., 1969.

In neutron diffraction, scattering that occurs owing to interaction between neutron moment and magnetic moment of the atom produces coherent diffraction peaks for ferromagnetic and antiferromagnetic materials. An example is cited of magnetic study of goethite, of importance in understanding magnetization of red beds. In Mössbauer spectra, in the case of paramagnetic ions (iron ions, for example), the magnetic field due to ion electrons splits the excited state into four hyperfine levels of spin and the ground state into two levels. Six radiative transitions are permitted resulting in the six-line Zeeman pattern usually observed when material is in the ferri- or antiferromagnetic state. An example is shown of the Zeeman pattern for maghemite. In maghemite, the magnetic moments of ferric ions on the tetrahedral and octahedral sites are coupled antiparallel and so the magnetic field at the nuclei of ions on the sites are antiparallel. — VSN

Oró, J. *See* Schneider, H. 01635

Oró, J. *See* Gelpi, E. 01683

Orr, William. *See* Hays, James D. 01429

01705 **Orsborn, John F.** Drainage density in drift-covered basins: Am. Soc. Civil Engineers Proc., v. 96, paper 7033, Jour. Hydraulics Div., no. HY 1, p. 183-192, illus., tables, 1970.

Drainage density, as determined for three drift-covered basins in north-central Wisconsin, has been correlated with mean annual flood flows and base flows. Deviations in the relationship for base flow from two basins are caused by ground-water gains and losses. Correcting for these deviations, drainage density has been related to the streamflow components of surface runoff and ground-water flow, taken as a percentage of total annual runoff. The original analysis of the data, and dimensional analysis, indicate that these streamflow components should be related to drainage density by a power function. This function is not continuous, and therefore a semilogarithmic relationship is developed which satisfies the basic requirement that the sum of surface runoff and baseflow must be total streamflow. The results are indicative of the influences of the soils and geology of the three basins on the streamflow components. — ASCE abstract

Orville, P. M. *See* Godchaux, M. M. 01764

Osborn, E. F. *See* Muan, A. 08977

Osborn, E. F. *See* Gee, K. H. 08978

Osborne, Robert H. *See* McDougall, Donald S. 01593

Ostenso, Ned A. *See* Wold, Richard J. 08878

08945 **Ostrom, John H.** Osteology of *Deinonychus antirrhopus*, an unusual theropod from the Lower Cretaceous of Montana [with German and Russian abs.]: Yale Univ. Peabody Mus. Nat. History Bull. 30, 165 p., illus., tables, 1969.

Skeletal anatomy and adaptations of *Deinonychus antirrhopus* Ostrom, 1969, a very unusual small carnivorous dinosaur from the Cloverly Formation at three localities south of Billings, Mont., are described in detail. Features indicate a fast-running and extremely agile obligatory biped, in carriage somewhat like a modern ostrich. The functionally didactyl pes has digit 2 specialized into an offensive structure bearing a large, recurved claw, adapted for cutting and slashing. The manus has three long, slender digits bearing large, raptorial, trenchant claws, and was capable of grasping and holding. The caudal vertebrae are not fused but have extremely elongated stiffening rods, believed to be ossified tendons; the tail is interpreted as a dynamic stabilizer acting as a single rigid body. *Deinonychus* is referred to Dromaeosauridae; a phylogeny is suggested. — VMJ

01433 **O'Sullivan, Robert B.** The upper part of the Upper Triassic Chinle Formation and related rocks, southeastern Utah and adjacent areas: U.S. Geol. Survey Prof. Paper 644-E, p. E1-E22, illus., 1970.

Division A, a reddish-orange siltstone at the top of the Chinle Formation, crops out chiefly in northeastern Arizona and extends not more than 8 miles into southeast Utah, where it grades into the fluviatile Hite Bed. In some areas, division A has been called Church Rock Member of the Chinle Formation but it is suggested here that it everywhere be called the Rock Point Member of the Wingate Sandstone. A Church Rock Member has been recognized in much of southeastern Utah below the Hite Bed, but this unit is stratigraphically different from division A and should be renamed. An unconformity below division A in northeast Arizona can be recognized widely in adjacent areas. — RBO'S

Ottemann, J. *See* Hach-Ali, P. Fenoll. 01460

01543 **Otvos, Ervin G., Jr.** High pressure shales and their depositional facies, southern Louisiana Cenozoic: Jour. Sed. Petrology, v. 40, no. 1, p. 412-417, illus., table, 1970.

The volume and proportion of overpressurized-low resistivity shale units in the middle and upper Cenozoic marine sediments of southern and off-shore Louisiana increases basinward with increasing depositional water depths. Middle and outer neritic low resistivity shales form the bulk of the studied high pressure shales. A decrease in the "low":"normal" resistivity shale ratios in Pliocene and Pleistocene sections is probably due to extreme undercompaction, resulting from lack of cohesion between shale particles. — Author's abstract

01549 **Overbey, W. K., Jr.; Henniger, B. R.** Disaggregation of sandstones by ultrasonic energy: Jour. Sed. Petrology, v. 40, no. 1, p. 465-472, illus., table, 1970.

Specific quantities of samples were used to test three ultrasonic generators with focussed horns utilizing varying degrees of acoustical intensity and frequencies for preset periods of time. Results indicate that (1) ultrasonic energy with acoustical power input between 55 and 100 watts per cm^2 and a frequency of 10 to 20 kilocycles per second can be successfully used to disaggregate friable to moderately cemented sandstones, (2) lower frequencies and higher intensities promote disaggregation and reduce the time required, and (3) rate of disaggregation is a function of the type of cementing materials involved, and may be controlled by the shape and volume of irradiation chamber and the pressure within the chamber. — *from* Authors' abstract

01508 **Oversby, Virginia M.; Gast, Paul W.** Isotopic composition of lead from oceanic islands: Jour. Geophys. Research, v. 75, no. 11, p. 2097-2114, illus., tables, 1970.

Lead isotopic composition studies reveal that the phonolitic rocks on St. Helena have Pb-207/Pb-204 ratios that are similar within the group but are very different from the Pb-207/Pb-204 ratios of basaltic rocks on St. Helena. It is suggested that this is due to original heterogeneity in the mantle U/Pb ratio. Two-stage and three-stage history models are considered. Trachyandesites from the 1961 flow on Tristan da Cunha show considerable variation in their lead isotopic composition indicating the presence of two lead components, one belonging to the original magma and the other presumably coming from the walls of a magma chamber. The distribution of lead

isotopic compositions from oceanic islands is discussed on a global scale. The implications of several models that attempt to explain the observed distribution pattern are discussed. — GV

Owens, James P. *See* Stefansson, Karl. 01478

Paaswell, Robert E. *See* Partheniades, Emmanuel. 01519

01810 **Page, Robert; Lahr, John.** Geodetic triangulation for fault movement on the Denali and Fairweather faults in Alaska [abs.]: EOS, v. 51, no. 4, p. 427, 1970.

Page, Robert. *See* Scholz, C. H. 01831

09081 **Palmer, Arthur N.** Cavern development in the Onondaga Limestone at the border of Appalachian deformation [abs.]: Natl. Speleol. Soc. Bull., v. 31, no. 2, p. 47, 1969.

01811 **Palmer, D. F.** Metamorphic conditions in the northwest Adirondacks [abs.]: EOS, v. 51, no. 4, p. 446, 1970.

01812 **Pan, Cheh.** The dynamical evolution of a layered earth [abs.]: EOS, v. 51, no. 4, p. 430, 1970.

01562 **Pandey, Sheo Ji.** Prediction and comparison of properties of Hawaiian and Indian red earths using automatic data processing techniques [abs.]: Dissert. Abs. Internat., Sec. B, Sci. and Eng., v. 30, no. 9, p. 3944B-3945B, 1970.

Papike, J. J. *See* Bence, A. E. 01738

Parcher, James V. *See* Townsend, Frank C. 09062

01866 **Parsons, Willard H.** Current status of Central American volcanoes [abs.]: EOS, v. 51, no. 4, p. 440, 1970.

01519 **Partheniades, Emmanuel; Paaswell, Robert E.** Erodibility of channels with cohesive boundary: Am. Soc. Civil Engineers Proc., v. 96, paper 7156, Jour. Hydraulics Div., no. HY 3, p. 755-771, illus., 1970.

Results of laboratory investigations are critically reviewed, summarized and compared with field results and older empirical information. There is strong experimental evidence, substantiated by physical reasoning, that bed shear stress strongly controls erosion and deposition of cohesive sediments. The net attractive interparticle forces in soil provide the main resistance to erosion. For low values soil shear strength does not have any measurable effect on soil erodibility, while for medium to high strength clays, resistance to erosion seems to increase with macroscopic strength. Under certain conditions erosion may stop after some scouring. A mechanistic model about interaction between bed surface and flow is described. Tentative rules are suggested for design of stable channels with cohesive boundaries. — *from* ASCE abstract

01448 **Paterson, W. S. B.** Excess pressure observed in a water-filled cavity in Athabasca Glacier, Canada [with French and German abs.]: Jour. Glaciology, v. 9, no. 55, p. 103-107, illus., table, 1970.

During drilling in the Athabasca Glacier in April 1968, a cavity containing water was punctured at a depth of 9.2 m below the ice surface. Upon removing the drill, water gushed from the bore hole for about 55 sec indicating an excess pressure of at least 0.25 bar within the cavity. The surrounding ice was slightly below the pressure melting point, and the excess pressure was apparently generated by the reduction in volume of the cavity caused by freezing of some of the water within it. — Author's abstract

01450 **Paterson, W. S. B.** The sliding veolcity of Athabasca Glacier, Canada [with French and German abs.]: Jour. Glaciology, v. 9, no. 55, p. 55-63, illus., tables, 1970.

A method of estimating sliding velocity is presented. It rests on few assumptions, one of which is that longitudinal strain-rate varies linearly with depth. The flow law of ice is not used. To apply it, the sliding velocity at one point must be known. The method is used to calculate the sliding velocity at 12 points on Athabasca Glacier. These values are not related to calculated basal shear stresses. Thus one or more of the following must be true: (1) basal shear stress cannot be calculated by the conventional formula, (2) the roughness of the glacier bed varies from place to place, (3) sliding velocity does not obey Weertman's formula. Analysis of seven published measurements of sliding velocity leads to the same conclusion. — Author's abstract

01587 **Pauken, Robert John, Jr.** A population study of the Pleistocene molluscan faunas in loess of the Missouri River basin in Missouri [abs.]: Dissert. Abs. Internat., Sec. B, Sci. and Eng., v. 30, no. 9, p. 4285B, 1970.

08935 **Pawluk, S.; Bayrock, L. A.** Some characteristics and physical properties of Alberta tills: Research Council Alberta Bull. 26, 72 p., illus., tables, 1969.

Maps depicting the regional variation in the chemical and mineralogical composition, and physical properties of tills from throughout the plains region of Alberta were prepared by a computer with an attached plotter. The chemical constituents and properties analyzed and discussed are: copper, zinc, manganese, calcium, boron, molybdenum, cobalt, pH, and soluble salts. The mineralogical components included are clay minerals and feldspars. The physical properties included are particle-size distribution, liquid limit and plastic limit, on the basis of which a number of additional engineering properties were calculated and discussed: plasticity number, plasticity, activity and corrosion potential. Generally, the lithology of the till closely reflects that of the underlying bedrock. A notable exception is the distribution of soluble salts, the origin of which is more likely related to ground-water phenomena. — Authors' abstract

01589 **Peak, Wilfred W.** California geologic registration—Where do you fit? [abs.]: Am. Assoc. Petroleum Geologists Bull., v. 54, no. 3, p. 554-555, 1970.

01454 **Pearce, T. H.** Chemical variations in the Palisade sill: Jour. Petrology, v. 11, no. 1, p. 15-32, illus., tables, 1970.

Application of a recently developed graphical technique to publish chemical data resulted in variation diagrams for the Palisade sill that are consistent with crystal fractionation of olivine and pyroxene from a single relatively homogeneous parent magma. — MS

01813 **Pearce, Thomas H.** The Crowsnest Volcanics and the genesis of analcite-bearing volcanics [abs.]: EOS, v. 51, no. 4, p. 442, 1970.

01594 **Pelkert, Ernest W.** Interactive computer graphics and the fault problem [abs.]: Am. Assoc. Petroleum Geologists Bull., v. 54, no. 3, p. 556-557, 1970.

Perret, W. R. *See* Merritt, M. L. 01632

Peselnick, L. *See* Byerlee, J. D. 01692

01698 **Peterman, Zell E.; Carmichael, I. S. E.; Smith, A. L.** Strontium isotopes in Quaternary basalts of southeastern California: Earth and Planetary Sci. Letters, v. 7, no. 5, p. 381-384, table, 1970.

Strontium isotope variations (Sr-87/Sr-86 of 0.7029 to 0.7052) in Quaternary basalts of southeastern California, U.S.A., are not readily explained by assimilation of crustal material similar to that contained as xenoliths in the basalt. Isotopic differences between chrome diopside (0.7016) and olivine (0.7078) from a lherzolite xenolith suggest that the isotopic variations in the basalts may be inherited from the source regions or modified by the upper parts of the mantle that were traversed by the lavas. — Authors' abstract

Petersen, C. F. *See* Ahrens, T. J. 09030

01446 **Petersen, Carl F.; Murri, William J.; Cowperthwaite, Michael.** Hugoniot and release-adiabat measurements for selected geologic materials: Jour. Geophys. Research, v. 75, no. 11, p. 2063-2072, illus., tables, 1970.

Release-adiabat curves have been determined for playa alluvium, tonalite, and novaculite shocked to stresses between 1 and 50 kb by plane impact from a light-gas gun. Particle-velocity/time profiles through the shock compression and the following release were measured at interfaces within the rock target and at the free surface using the principle of a moving conductor in a magnetic field. Steep release-adiabat curves in the stress-volume plane and high rarefaction velocities have been determined for alluvium and tonalite, indicating irreversible compaction. For alluvium, the initial rarefaction velocities are twice the shock velocities, which would cause rapid attenuation of the shock wave propagated in a field experiment. For novaculite, shocked below the Hugoniot elastic limit, the release-adiabat curve lies very close to the Hugoniot. The techniques should be applicable at higher stresses to study such problems as the kinetics of shock-induced phase changes. — Authors' abstract

Peterson, Donald L. *See* Kleinkopf, M. Dean. 01468

01814 **Petrović, Radomir; Skinner, Brian J.** Deformation of alkali feldspars as a consequence of alkali diffusion [abs.]: EOS, v. 51, no. 4, p. 439, 1970.

Péwé, Troy L. *See* Weber, Florence R. 01509

01498 **Philberth, K.; Federer, B.** A note on the surface profile of the Greenland ice sheet [with French and German abs.]: Jour. Glaciology, v. 9, no. 55, p. 150-153, table, 1970.

This paper deals with the influence on the surface profile of the ice sheet, of an accumulation which increases between ice divide and coast, and of thermal softening of lowermost layers. It is concluded that the form of the profile surface measured by E.G.I.G. can be described by Glen's law with the exponent $n = 3.5$. It is assumed that the bottom temperature differs everywhere from the pressure melting point by a constant amount. On the basis of the measured surface profile it is shown that maximum increase of bottom temperature is a few degrees within a range of 300 km. In view of increasing surface temperature and heat of friction towards the outer edge it is concluded that, relatively close to the ice divide, the ice at the bottom must be temperate. Therefore, friction forces are preventing the ice from slipping on bedrock. — *from* Authors' abstract

01651 **Philcox, Michael E.** Geometry and evolution of the Palisades Reef Complex, Silurian of Iowa: Jour. Sed. Petrology, v. 40, no. 1, p. 171-183, illus., tables, 1970.

The first growth phase of the complex, represented by the crinoid-coelenterate facies, consists of a large number of crinoid mounds, which are most highly differentiated in the Marginal (windward) Zone, large but simpler in the Main Crinoid Zone, and small or absent in the Leeward Zone. The Marginal Zone mounds are themselves asymmetrical, a late-stage blanket of Coelenterate Beds on their windward sides only. The second growth phase is represented in the Marginal Zone by the "Brady facies," consisting mainly of laminated dense dolomite but including thick beds of rhynchonellids. The facies forms large-scale wedge-beds on the mound flanks, and is believed to have been derived from a platform on top of the earlier crinoid mounds. The Brady facies grades into beds consisting almost entirely of laminated dolomite (Anamosa). In the Leeward Zone, the second growth phase is represented solely by Anamosa dolomites. — *from* Author's abstract

01815 **Philpotts, A. R.** Immiscibility between critically undersaturated basic and oversaturated felsic magmas [abs.]: EOS, v. 51, no. 4, p. 438, 1970.

01867 **Philpotts, John A.** Redox estimation from a calculation of Eu^{2+} and Eu^{3+} concentration in natural phases [abs.]: EOS, v. 51, no. 4, p. 451, 1970.

Phinney, R. A. *See* Anderson, D. L. 08970

Pickens, W. R. *See* Klohn, M. L. 08929

01567 **Pickering, Dennison John.** A simple shear machine for soil [abs.]: Dissert. Abs. International., Sec. B, Sci. and Eng., v. 30, no. 9, p. 4125B, 1970.

01434 **Pickering, R. J.** Composition of water in Clinch River, Tennessee River, and Whiteoak Creek as related to disposal of low-level radioactive liquid wastes: U.S. Geol. Survey Prof. Paper 433-J, p. J1-J15, illus., tables, 1970.

The fate of radioactive wastes and mechanisms by which radionuclides are dispersed in Clinch River were investigated, to evaluate its use for disposal of such wastes released to tributary Whiteoak Creek, 20.8 mi upstream from the juncture of Clinch and Tennessee Rivers. Analyzed compositely over 3 years for physical parameters, stable chemical and radiochemical constituents, and suspended sediment, water samples from all three streams were of calcium bicarbonate type related to abundance of limestone and dolomite bedrock of their drainage basins. Constituents varied with seasonal contribution of ground water and dilution of wastes. Suggested associations were: Fe and Mn primarily with suspended solid particles; released Cs-137 with solids larger than colloidal particles until dissolved in Tennessee River or associated with colloidal solids; Sr-90 perhaps with precipitated calcium carbonate; and Ru-106 and Co-60 in nitrate solutions released to Whiteoak Creek. — GDC

Pierce, J. W. *See* Yochelson, E. L. 01501

01600 **Pierce, Richard L.** Preliminary revaluation of late Miocene biostratigraphy of California [abs.]: Am. Assoc. Petroleum Geologists Bull., v. 54, no. 3, p. 559, 1970.

Pinder, George F. *See* Trescott, Peter C. 01608

09100 **Piper, Arthur M.** Disposal of liquid wastes by injection underground — Neither myth nor millenium, *in* Water, 1969 (L. K. Cecil, editor) — Chem. Eng. Prog. Symposium Ser., No. 97, V. 65: New York, Am. Inst. Chem. Engineers, p. 5-18, table, 1969.

This paper discusses some of the problems and hazards involved in the disposal of liquid wastes by injection underground [in particular those of the Rocky Mountain Arsenal well, near Denver, Colo.]. To minimize these hazards, the author proposes (1) standards be determined to categorize the various wastes, (2) an immediate and comprehensive canvass of all the United States to outline injection provinces and zones according to their capacities to accept waste, and (3) an institutional arrangement under a unified policy to regulate injection of industrial wastes. — Author's abstract

01463 **Plafker, George; MacKevett, E. M., Jr.** Mafic and ultramafic rocks from a layered pluton at Mount Fairweather, Alaska, *in* Geological Survey research 1970, Chap. B: U.S. Geol. Survey Prof. Paper 700-B, p. B21-B26, illus., tables, 1970.

Reconnaissance mapping in the Fairweather Range of southeastern Alaska has revealed that a layered mafic and ultramafic pluton, the Fairweather pluton, underlies much of the Mount Fairweather area. The mafic rocks, which constitute most of the pluton, are magnetite- and ilmenite-bearing two-pyroxene gabbros and clinopyroxene-olivine gabbros. The ultramafic rocks consist mainly of sulfide- and chromite-bearing wehrlite, pyroxenite, and dunite, and locally contain significant concentrations of chromium, cobalt, copper, nickel, and platinum-group elements. The pluton is probably a source for ilmenite, magnetite, platinum, and other heavy minerals that have been found as placer beach deposits along the adjacent Gulf of Alaska coast. — Authors' abstract

Plinston, David T. *See* Kemp, Patrick H. 01526

01514 **Pluhowski, E. J.** Hydrology of the upper Malad River basin, southeastern Idaho: U.S. Geol. Survey Water-Supply Paper 1888, 89 p., illus., tables, 1970.

An extensive ground-water reservoir consisting of sand and gravel interbedded with relatively impermeable beds of silt and clay underlies much of the semiarid Malad Valley; wells near the valley's center exceeding 700 feet in depth do not reach

bedrock. The Woodruff fault, which transects the constricted lower valley, is one of the main factors creating artesian conditions south of the latitude of Malad City. Recharge is obtained principally from mountain runoff which flows onto highly permeable alluvial fans surrounding the valley and from streams that flow across the valley floor. A shortage of suitable reservoir sites has hampered surface-water development in the principal tributary valleys; highly porous deposits underlying the valley tend to attenuate flood peaks. The total water yield is not sufficient to meet all needs of the basin; a comprehensive water-management plan is required to ensure optimal use of the water resources. — *from* Author's abstract

01729 **Podosek, F. A.** Dating of meteorites by the high-temperature release of iodine-correlated Xe^{129}: Geochim. et Cosmochim. Acta, v. 34, no. 3, p. 341-365, illus., tables, 1970.

Formation times in m.y. of nine specimens were obtained from the initial ratio I-129/I-127 determined from Xe-129 and Xe-128 quantities. They are: 3.1 ± 0.6 and 10.5 ± 0.7 for Karoonda; 3.1 ± 0.6 and 10.5 ± 0.7 for the matrix and chondrules, respectively, of Chainpur; 7.5 ± 1.0 for St. Severin; 3.9 ± 2.9 and 2.3 ± 1.0 for the matrix and chondrules, respectively, of Allegan; 3.6 ± 0.7 for Pena Blanca Spring and 20.8 ± 9.5 for Bishopville; and 3.8 ± 0.7 for a silicate inclusion of the iron meteorite El Taco. The reliability of I-Xe ages of individual meteorites is considered and the relevance of I-Xe dating theories of nucleosynthesis, early solar system chronology, and theories of meteorite parent-body formation is discussed. — GV

09045 **Poole, Donald H.** Slope failure forms — Their identification, characteristics, and distribution as depicted by selected remote sensor returns, *in* Symposium on remote sensing of environment, 6th Internat., Ann Arbor, Mich., 1969, Proc., V. 2: Ann Arbor, Mich., Univ. Michigan, Willow Run Labs., p. 927-965, illus., table, 1969.

Aerial photography, particularly Ektachrome and Ektachrome infrared, can supply detailed information about slope failure forms. Objectives in this study of analytical photo procedures and their application to slope failure forms were to develop criteria for recognizing and identifying these forms and to test or evaluate the criteria and remote sensor imagery by mapping distribution of slope failure forms. Results indicate that such mapping can be achieved relatively easily and rapidly providing suitable aerial photographs are available, especially if the interpreter has criteria in mind to be applied in recognizing and identifying forms. Small-scale photography suitable for most slope failure studies should be at a scale of 1/20,000. Large-scale photography (1/10,000 or larger) would be suitable for microstudies of slope failure phenomena. — *from* Author's abstract

01680 **Porath, H.; Oldenburg, D. W.; Gough, D. I.** Separation of magnetic variation fields and conductive structures in the western United States: Royal Astron. Soc. Geophys. Jour., v. 19, no. 3, p. 237-260, illus., table, 1970.

The variation field of a polar substorm was recorded by an array of 42 variometers in the western United States. A semicircular upheaval of radius 150 km from an unperturbed level at depth 360 km models the anomaly related to the Southern Rockies. A step of height 120 km at the Wasatch Front, together with a semicylinder of radius 100 km under the Wasatch fault belt, give a good approximation to the observed anomaly at the Wasatch Front. The actual structures may be somewhat shallower and smoother. The real conductivity is estimated at 2.10^{-12} e.m.u., a value which would be expected at temperatures near 1500°C. Such temperatures are reasonable at the depths concerned. — *from* Authors' summary

Porath, H. *See* Reitzel, J. S. 01856

01816 **Post, Robert L., Jr.** The flow laws of Mt. Burnett dunite at 750°C-1150°C [abs.]: EOS, v. 51, no. 4, p. 424, 1970.

09046 **Pouquet, J.** Geopedological features derived from satellite measurements in the 3.4-4.2μ and 0.7-1.3μ spectral regions, *in* Symposium on remote sensing of environment, 6th Internat., Ann Arbor, Mich., 1969, Proc., V. 2: Ann Arbor, Mich., Univ. Michigan, Willow Run Labs., p. 967-988, illus., tables, 1969.

An investigation of Nimbus III satellite infrared daytime and nighttime data has revealed that nighttime emitted radiations underline pedologic or geopedologic features whereas daytime reflected infrared is more closely related to geologic features. — VSN

01427 **Powell, W. J.; Copeland, C. W.; Drahovzal, J. A.** Space-acquired data for Alabama: Geotimes, v. 15, no. 4, p. 14-15, illus., 1970.

Apollo 9 multispectral photographs of east-central Alabama, between Birmingham and the Georgia state line permit significant regional interpretation of topographic, vegetal, geologic and hydrologic patterns. Most significant are lineations intersecting Appalachian structural axes; most and longest traces, oriented N 20°W to N 50°W with little or no offset, are thought to be fractures due to a reoriented stress field after the main orogeny. There is apparent coincidence with areas of known anomalous streamflow, large wells and springs, quarry drainage, and dam-leakage problems. Topography on resistant rock units clearly defines formations and strike directions; known sun angle provides a clue to dips by shades of slope faces. A general color change along trace of the Cartersville thrust fault is probably related to diversity of Piedmont metamorphic and Ridge and Valley sedimentary rock units, elevation, and land use. — GDC

01611 **Powell, W. J.; Copeland, C. W.; Drahovzal, J. A.** Delineation of linear features and application to reservoir engineering using Apollo 9 multispectral photography: Alabama Geol. Survey Inf. Ser. 41, 37 p., illus., tables, 1970.

Four multispectral photographs of east-central Alabama made by the Apollo 9 crew cover 6,400 sq mi between Birmingham and the Georgia line; principal cultural, geologic, topographic, hydrologic, and vegetative features are clearly visible. Apparent coincidences of relatively straight long lineations with areas of known anomalies of streamflow, of large capacity wells and springs, quarry drainage, and dam leakage indicate they have not only a marked geologic effect, but may also be of great hydrologic, environmental, and economic significance. Interpretations indicate the following applications: determining areas of ground-water movement and availability, for making low-flow measurements, and locations of gaging stations; locating sites of optimum hydrogeologic conditions for dam and reservoir construction; and as aids in geologic mapping and study of structural geology. — *from* Authors' abstract

Price, P. B. *See* Fleischer, R. L. 08973

09011 **Purvis, A. E.; Buckmeier, F. J.** Comparison of airborne spectral gamma radiation data with field verification measurements, *in* Symposium on remote sensing of environment, 6th Internat., Ann Arbor, Mich., 1969, Proc., V. 1: Ann Arbor, Mich., Univ. Michigan, Willow Run Labs., p. 553-564, illus., tables, 1969.

In recent experiments, potassium-40 counting rate data from airborne measurements showed good correlation with the available field gamma radiation data and soil type information. From field measurements, sandy surface material exhibited a potassium-40 counting rate of 21,700 ± 3,600 counts/10 min while clay surface materials exhibited counting rates of 33,800 ± 3,500 counts/10 min. The investigation included measurements to determine the effect of aircraft altitude on the observed gamma radiation flux. Also studied was the interrelationships between the flux observed by a detector suspended from a tripod 8 feet above the surface and the concentrations of thorium, uranium and potassium obtained from laboratory analyses of soil samples. — Author's abstract

01817 **Pushkar, Paul.** Sr-87/Sr-86 ratios of volcanic rocks on and near the Colorado Plateau [abs.]: EOS, v. 51, no. 4, p. 444, 1970.

09131 **Pyle, Thomas E.; Antoine, John W.; Fahlquist, Davis A.; Bryant, William R.** Magnetic anomalies in Straits of Florida: Am. Assoc. Petroleum Geologists Bull., v. 53, no. 12, p. 2501-2505, illus., 1969.

In the abstract for this paper, cited in "Abstracts of North American Geology" for June 1970, "magnetic anomalies greater than 1000 gammas" should be corrected to read "magnetic anomalies greater than 100 gammas." — VSN

09071 **Quinlan, James F.** Geology and hydrology of sinkholes formed by solution of gypsum by artesian water, Pecos River valley, New Mexico [abs.]: Natl. Speleol. Soc. Bull., v. 31, no. 2, p. 39-40, 1969.

Ragent, Boris. *See* Hruby, Ronald J. 09095

08914 **Rainey, Henry C., 3d; Miller, Robert C.** Geologic map of the Lewisburg quadrangle, Logan County, Kentucky: U.S. Geol. Survey Geol. Quad. Map GQ-830, scale 1:24,000, section, 1969.

01627 **Raleigh, C. B.; Hoskins, E. L.; Kirby, S. H.** Deep-hole determinations of strain and in-situ stress related to the JORUM event [abs.]: EOS, v. 51, no. 3, p. 203, 1970.

09120 **Ramos Orozco, M.** Problemas geofísicos de la porción norte de la Faja de Oro [abs.]: Inst. Mexicano Petróleo Rev., v. 1, no. 3, p. 82, 1969.

01521 **Rand, Walter.** Sill-controlled flow transitions and extent of erosion: Am. Soc. Civil Engineers Proc., v. 96, paper 7212, Jour. Hydraulics Div., no. HY 4, p. 927-939, illus., table, 1970.

The distance is determined over which scour will develop downstream of a sill-controlled flow transition in an erodible open channel, in which the sediment motion is impending. This determination is based on the concept of dynamic similarity that makes it possible to relate the erosion length in an erodible channel to the total length of flow transition in a fixed-bed channel. Accordingly, prediction of the limiting extent of erosion becomes possible for a wide variety of sill-controlled flow transitions, including the cases present in the hydraulic jump stilling basins, and the natural hydraulic jump. — ASCE abstract

Randall, Walter. *See* Hail, W. Roger. 01773

01818 **Rankin, Douglas S.; Hyndman, Roy D.** Shallow water heat-flow measurements in Bras d'Or Lake, Nova Scotia [abs.]: EOS, v. 51, no. 4, p. 426, 1970.

01528 **Rao, Udayagiri Mohan.** Sediment measurement techniques — [Pt.] F, Laboratory procedures — Discussion [of paper 6757 by Am. Soc. Civil Engineers (Task Comm. on Preparation of Sedimentation Manual), 1969]: Am. Soc. Civil Engineers Proc., v. 96, Jour. Hydraulics Div., no. HY 5, p. 1215-1220, tables, 1970.

Rao discusses one topic in the paper (ibid., v. 95, no. HY 5, p. 1515-1543), the desirability of determination of the shape factor in terms of a, b, c in the case of particles which are not close to spherical. The volume-surface area relation is important in sedimentation and true sphericity as defined by Wadell appears to be the best shape parameter. Topics discussed are sphericity expressions, rectangular parallelepiped, comparison of different shape parameters, and roundness. — ESL

Rase, Daniel E. *See* Davis, Douglas. 09053

09073 **Rauch, Henry.** Cave-controlling geologic parameters within the Nittany Valley area of central Pennsylvania [abs.]: Natl. Speleol. Soc. Bull., v. 31, no. 2, p. 40, 1969.

09075 **Rauch, Henry.** Control of cavern development by stratigraphic dip within the Nittany Valley area of central Pennsylvania [abs.]: Natl. Speleol. Soc. Bull., v. 31, no. 2, p. 41-42, 1969.

Ravina, Israela. *See* Low, Philip F. 01725

09077 **Reams, Max W.** Cave sediments and Ozark geomorphic history [abs.]: Natl. Speleol. Soc. Bull., v. 31, no. 2, p. 42-43, 1969.

08875 **Reed, John C.** Naval Petroleum Reserve No. 4 — Then and now [abs.]: Geophysics, v. 34, no. 6, p. 1006, 1969.

Reeves, J. E. *See* Brady, J. G. 09052

08937 **Reeves, Richard D.** Ground-water resources of Kerr County, Texas: Texas Water Devel. Board Rept. 102, 58 p., illus., tables, 1969.

Most of the water used in Kerr County is obtained from ground-water sources, principal aquifers being (from oldest to youngest) the Hosston and Sligo Formations, Hensell Member of the Pearsall Formation, and Edwards and associated limestones. About 3,600 acre-feet or 3.2 mgd of ground water was pumped from wells in 1966. The area most favorable for development of large-capacity wells from the Hosston, Sligo, and Pearsall Formations is in the southern half of the county. Chemical quality is generally suitable for public supply and industrial use, and is excellent for irrigation. — MCM

08938 **Rehder, Harald A.** Appendix [to "Taxonomic revision of the superspecific groups of the Cretaceous and Ceonzoic Tellinidae" by F. Afshar]: Geol. Soc. America Mem. 119, p. 97-107, 192-198, illus., 1969.

Genera and subgenera of Tellinidae proposed after completion of Afshar's manuscript in 1952 are cited herein — three additional subgenera of *Tellina*, and the additional genus *Bathytellina* Habe, 1958, with eight subgenera. For each taxon, the bibliographic reference and type-species designation is followed by the diagnosis copied verbatim from the original publication; each type species is described and figured. Rehder adds comments as to the probable positions of these taxa within Afshar's classification. — VMJ

01819 **Reid, John B., Jr.** The role of lherzolite and spinel-pyroxenite in the formation of basaltic magmas [abs.]: EOS, v. 51, no. 4, p. 447-448, 1970.

Reimer, M. *See* Wagner, G. A. 01846

09028 **Reinhardt, E. W.** Geology of the Precambrian rocks of Thubun Lakes map-area in relationship to the McDonald Fault system, District of Mackenzie (75E/12 and parts of 75E/13 and 85H/9): Canada Geol. Survey Paper 69-21, 29 p., illus., geol. map, 1969.

Petrologic and structural history of metamorphic and granitic rocks were examined during 1-mi to 1-in geologic mapping; about 150 thin sections were studied. The oldest rocks probably represent Yellowknife-type sediments and volcanics in higher-grade metamorphism than commonly found in the Slave Province; typical mineral assemblages are AFM projected. Granitic rocks, in three mappable units, assimilated metasedimentary material, and now dominate layered migmatites of two northeast-trending, fault-separated belts. Penetrating shear of transcurrent faulting in the same trend (McDonald system) produced widespread mylonites, cataclasites, and secondary foliation of low-grade retrograde metamorphism; subsequently there was vertical faulting in the same fracture pattern, and later NNW-striking faults of minor displacement partly occupied by diabase dikes and sulfide-mineralized quartz veins. — GDC

01820 **Reitan, Paul H.; Szekely, Julian; Foster, B. P.** Material emplacement models for dikes extending to the mantle [abs.]: EOS, v. 51, no. 4, p. 447, 1970.

01856 **Reitzel, J. S.; Gough, D. I.; Porath, H.; Anderson, C. W., 3d.** Geomagnetic deep sounding and upper mantle structure in the western United States: Royal Astron. Soc. Geophys. Jour., v. 19, no. 3, p. 213-235, illus., 1970.

Magnetic field time variations observed in September 1967 between lat 36° and 43°N. and long 101°W. and 116°W. indicate a ridge of high conductivity no more than 200 km under the Southern Rocky Mountains between the Great Plains and the Colorado plateau, which marks a low-conductivity region within the Cordillera. A strong conductivity anomaly along the Wasatch Front indicates an upwelling of

highly conductive material at no more than 120 km along the edge of a step structure. The conductive mantle is shallower under the Basin and Range Province than under the Colorado Plateau, and rises between the north-south structures, from the Colorado Plateau southward to the Basin and Range. The daily variation indicates the great extent in depth of the conductivity structures. The anomalies are in excellent agreement with heat flow data. — *from* Authors' summary

Reitzel, J. S. *See* Gough, D. I. 09018

Reveal, James L. *See* Tidwell, William D. 01677

Rex, R. W. *See* Meidav, Tsvi. 01688

Rex, Robert W. *See* Hail, W. Roger. 01773

Richards, M. L. *See* Francheteau, Jean. 01445

01437 **Richter, Donald H.** Geology and lode-gold deposits of the Nuka Bay area, Kenai Peninsula, Alaska: U.S. Geol. Survey Prof. Paper 625-B, p. B1-B16, illus., tables, geol. maps, 1970.

Nuka Bay is on the southeast coast of the Kenai Peninsula approximately 60 miles from the Port of Seward. Gold-bearing quartz veins were mined in the area between 1920 and 1940. Bedrock in the area is a Cretaceous section of slate and graywacke deformed into relatively open but overturned folds plunging to the northeast. Small granodiorite dikes fill tensional cross joints in the folded rocks. The quartz veins are thin and discontinuous and consist of quartz with arsenopyrite, minor other sulfides, and native gold. The veins generally dip steeply and strike east-west and appear confined to competent graywacke or dikes. A few stream sediments in the area contain detectable gold. The area may be a potential minor gold producer. — DHR

01821 **Riehle, James R.** Theoretical compaction profiles in ash-flow tuffs [abs.]: EOS, v. 51, no. 4, p. 442, 1970.

01507 **Riley, Francis S.** Land-surface tilting near Wheeler Ridge, southern San Joaquin Valley, California: U.S. Geol. Survey Prof. Paper 497-G, p. G1-G29, illus., 1970.

This pumping-plant site for the California Aqueduct borders a bowl of local subsidence caused by compaction of confined aquifer under decline of artesian head and by near-surface hydrocompaction of moisture-deficient fan deposits. Two liquid-level tiltmeters, and associated borehole extensometers in the upper 150 feet of the fans, recorded an abrupt northwestward summer tilting toward nearby areas of intense pumping; its magnitude of 46 microradians was roughly half the annual rate postulated from 1960-65 spirit levelings. With stable conditions in autumn, a very slow but steady background tilting to the northeast may be due to a continuing anticlinal uplift. Differences in magnitude and timing between responses of tiltmeters and compaction sensors indicated susceptibility to hydrocompaction deeper than 150 feet. In an array of bench marks within 2,400 feet of the site, six late-summer levelings support two tilting periods coinciding with winter and summer irrigations. — GDC

Riley, Leonard B. *See* Huffman, Claude, Jr. 01482

01822 **Rinehart, John S.** Effect of earth tides on geyser performance [abs.]: EOS, v. 51, no. 4, p. 432, 1970.

01510 **Ritter, J. R.** A summary of preliminary studies of sedimentation and hydrology in Bolinas Lagoon, Marin County, California: U.S. Geol. Survey Circ. 627, 22 p., illus., tables, 1970.

The U.S. Geological Survey is investigating sedimentary and hydrologic conditions in Bolinas Lagoon, a 1,100-acre lagoon 15 miles northwest of San Francisco. The program began in May 1967 and will continue into 1970. Only the study results analyzed

before June 1968 are summarized in the report. Two series of measurements of suspended-sediment load and water discharge in the lagoon inlet showed that much of the suspended sediment is sand and that the average velocity was as much as 4.7 feet per second. Littoral drift near the inlet was generally toward the inlet, whereas farther from the inlet the pattern is irregular. Circulation velocities in the lagoon decrease rapidly away from the inlet, but probably remain high enough to erode bottom sediment along the channels. In most of the lagoon median size of bottom sediment was fine sand. Sediment was derived chiefly from Monterey Shale. — Author's abstract

09003 **Roberts, George D.** Predictions of reservoir leakage, *in* Reservoir leakage and groundwater control: Assoc. Eng. Geologists Bull., v. 6, no. 1, p. 70-82, illus., 1969.

Where a ground-water study shows that the elevation of the adjacent ground water is higher than that of the proposed reservoir, water will seep into the reservoir. Leakage, in contrast to seepage, is a water loss that constitutes a potential hazard or serious economic loss. A ground-water study, whose cost is low, is an investment which yields a high economic return in terms of trouble and expenses avoided; it should be done during the initial part of the investigation for a dam and will indicate economic feasibility of the proposed project and areas that may require treatment to prevent leakage. Continuation of such studies during the first years of reservoir operations will usually detect changes in water levels, which could develop leakage, in time to permit economical treatment. — *from* Author's abstract

01578 **Roberts, Harry Hell.** Recent carbonate sedimentation, North Sound, Grand Cayman Island, British West Indies [abs.]: Dissert. Abs. Internat., Sec. B, Sci. and Eng., v. 30, no. 9, p. 4210B, 1970.

Robinson, Paul T. *See* Elders, Wilfred A. 01758

01823 **Robinson, Paul T.; Elders, Wilfred A.** Possible sea-floor spreading in the Imperial Valley of California — [Pt.] 3, Xenoliths in rhyolite volcanoes as samples of the basement [abs.]: EOS, v. 51, no. 4, p. 422, 1970.

Rodine, James. *See* Colburn, Ivan P. 01605

Roeder, D. H. *See* Nelson, T. H. 01806

08913 **Rogers, C. L.; Noble, Donald C.** Geologic map of the Oak Spring Butte quadrangle, Nye County, Nevada: U.S. Geol. Survey Geol. Quad. Map GQ-822, scale 1:24,000, sections, 1969.

09114 **Rogers, George R.** Future utilization of mining geophysics: Mining Cong. Jour., v. 55, no. 4, p. 55-61, illus., 1969.

Two general approaches to reconnaissance geophysics are emerging — saturation exploration as used in Canada on areas of extensive shallow cover, and sequential exploration as used in western North America; electromagnetic systems have been successful in the former, and in the western United States, rock cover requires the sequential approach. Aeromagnetic and gravity surveys are often employed in the early stages. The Lordsburg-Deming area, N. Mex., is an example of a gravity survey. In Canada, from 1955-59 about 125,000 sq mi were surveyed by airborne electromagnetometer, 3,000 of 10,000 anomalies were followed by ground work, 1,000 were drilled, and 16 potential orebodies found. The induced polarization method has shown the greatest growth, drill-hole logging will also increase, considerable work is being done with remote sensing, and the role of computers in increasing. — ESL

01564 **Romans, Robert Charles.** Palynology of some Upper Cretaceous coals of Black Mesa, Arizona [abs.]: Dissert. Abs. Internat., Sec. B, Sci. and Eng., v. 30, no. 9, p. 4008B-4009B, 1970.

01624 **Romig, Philip R.; Wideman, C. J.; VanWormer, J. D.; Tocher, Don.** Strain steps from the nuclear explosion JORUM [abs.]: EOS, v. 51, no. 3, p. 202, 1970.

08876 **Roots, E. F.** The operation and management of Arctic scientific activities — Lessons from the Polar Continental Shelf Project [abs.]: Geophysics, v. 34, no. 6, p. 1006, 1969.

Rose, William I., Jr. *See* Stoiber, Richard E. 01837

Rosholt, J. N. *See* Szabo, B. J. 01470

09035 **Routson, R. C.; Wildung, R. E.** Ultimate disposal of wastes to soil, *in* Water, 1969 (L. K. Cecil, editor) — Chem. Eng. Prog. Symposium Ser., No. 97, V. 65: New York, Am. Inst. Chem. Engineers, p. 19-25, 1969.

The soil is a suitable medium for the ultimate disposal of wastes which will either be transformed into innocuous forms or recycled and removed as agricultural crops. Thus, ultimate soil disposal should be limited to major plant nutrient elements, radionuclides with practical half-lives, and biodegradable organic materials. Efficient soil sorption should not be the sole criterion used in evaluation of the soil as a medium for waste disposal. For example, heavy solutions can be contaminated by soil percolation, but many are toxic to plants even in small quantities. The rate and extent of recyclization or dissipation of soil amended inorganic or organic wastes will be dependent upon the properties of the waste and of the soil. — Authors' abstract

Roy, Robert F. *See* Williams, David L. 01854

01424 **Rozendal, R. A.; Erskine, W. S.** Deep test in the Ouachita structural belt of central Texas [abs.]: Houston Geol. Soc. Bull., v. 12, no. 6, p. 18, 1970.

01643 **Ruddiman, W. F.; Tolderlund, D. S.; Bé, A. W. H.** Foraminiferal evidence of a modern warming of the North Atlantic Ocean: Deep-Sea Research, v. 17, no. 1, p. 141-155, illus., tables, 1970.

A comprehensive numerical comparison of living and fossil assemblages of planktonic Foraminifera on an ocean-wide scale suggests that the present ocean is 1.5-2.0°C warmer than a mixed late Recent average. More than 300 core top samples distributed beneath the major North Atlantic water masses as far north as 60°N. were compared with mean annual species compositions of five open-ocean plankton stations in the western Atlantic from Bermuda to the Labrador Sea combined with a total of 437 plankton samples collected in 1959-63. Core assemblages most closely resembling each of the composite modern plankton averages are consistently displaced to the south and east towards regions of warmer surface waters. The simplest explanation of this geographic shift is that of a recent ocean warming. The temperature deviation of 1.5-2.0°C is large for an interval that is generally considered part of the stable climatic regime of a postglacial phase. — *from* Authors' abstract

08952 **Runcorn, S. K.** (editor). The application of modern physics to the earth and planetary interiors — Conf., Univ. Newcastle upon Tyne, England, 1967: London and New York, Wiley-Interscience, 692 p., illus., tables, 1969.

The fifty-one papers in this proceedings are grouped under the headings cosmology and geophysics, solid state physics and geophysics, high-pressure physics and the Earth's interior, developments in techniques, magnetohydrodynamics, and the Earth as a fundamental physics laboratory. Thirty-two papers are cited separately. — VSN

Rushforth, Samuel R. *See* Tidwell, William D. 01677

Russell, Ernest E. *See* Garman, R. Keith. 09042

01532 **Russell, R. Dana.** SEPM history: Jour. Sed. Petrology, v. 40, no. 1, p. 7-28, illus., 1970.

The history is reviewed of the wranglings and financial difficulties during the first 20 years of existence of the Society of Economic Paleontologists and Mineralogists, particularly in regard to establishment of the *Journal of Paleontology* and the *Journal of Sedimentary Petrology*. — VSN

Russell, William H. *See* Fish, John. 09083

01824 **Rutherford, Malcolm J.** Phase relations in the system Al_2O_3-SiO_2-Fe-O-H at P_{fluid} = 2kb [abs.]: EOS, v. 51, no. 4, p. 437, 1970.

01825 **Rutstein, Martin S.; White, William B.** Optical and infrared spectra of high calcium pyroxenes [abs.]: EOS, v. 51, no. 4, p. 436, 1970.

Ryall, Alan. *See* Boucher, Gary W. 01626

01622 **Sacks, I. S.; Evertson, D. W.** A sensitive borehole strain-rate meter: Carnegie Inst. Washington Year Book 68, 1968-69, p. 448-452, illus., 1970.

Saénz R., Rodrigo. *See* Simon, Ivan. 01868

01464 **Sainsbury, C. L.; Coleman, R. G.; Kachadoorian, Reuben.** Blueschist and related greenschist facies rocks of the Seward Peninsula, Alaska, *in* Geological Survey research 1970, Chap. B: U.S. Geol. Survey Prof. Paper 700-B, p. B33-B42, illus., table, 1970.

Blueschist facies rocks of Precambrian age are exposed in thrust slices over an area of more than 10,000 square miles of the Seward Peninsula, Alaska. Rocks with mineral assemblages characteristic of high-grade blueschist facies and retrograde blueschist facies occur juxtaposed against low-rank metamorphic pelitic and carbonate rocks, possibly because of thrust faults. From west to east over the Seward Peninsula, progressive regional metamorphism of Cretaceous(?) age and extensive overthrust faulting of pre-mid-Cretaceous age have complicated the metamorphic assemblages. Field evidence proves that the blueschist rocks represent metavolcanic rocks and metamorphosed mafic rocks of late Precambrian age. Mineral assemblages are strongly influenced by the original chemical composition of the rocks. — Authors' abstract

08944 **Sainsbury, C. L.; Kleinhampl, F. J.** Fluorite deposits of the Quinn Canyon Range, Nevada: U.S. Geol. Survey Bull. 1272-C, p. C1-C22, illus., geol. maps, 1969.

Fluorite deposits are scattered widely in an area about 15 miles square in the Quinn Canyon Range, some 90 miles south of Ely, Nev. The deposits consist of irregular replacement bodies and breccia fillings in limestone of Paleozoic age and of veins and veinlets in tabular altered zones in volcanic rocks of Tertiary age. Many of the deposits are associated with rhyolite porphyry dikes that intrude both limestone and volcanic rocks and trend northeast and east-northeast. Some deposits in limestone contain ore averaging as much as 90 percent CaF_2, and are considered to be more promising than the deposits in altered volcanic rocks, which generally contain ore of lower grade. Deposits of metallic minerals, described by previous workers and consisting of argentiferous base-metal deposits and gold-quartz veins, were examined and are located on the reconnaissance map with the fluorite deposits. — Authors' abstract

Salamis, C. *See* Gaucher, Edwin. 08883

01826 **Salotti, Charles A.** The relative measurement of monatomic zinc vapor from franklinite, willemite, and zincite [abs.]: EOS, v. 51, no. 4, p. 437, 1970.

Sammis, C. G. *See* Anderson, D. L. 08970

Sammis, Charles. *See* Anderson, Don L. 08991

01681 **Sammis, Charles G.** The pressure dependence of the elastic constants of cubic crystals in the NaCl and spinel structures from a lattice model: Royal Astron. Soc. Geophys. Jour., v. 19, no. 3, p. 285-297, illus., tables, 1970.

The method of homogeneous static deformation is used to compute the pressure dependence of the elastic constants of spinel under the assumption of a Born-Mayer two-body potential. The method, originally used by Fuchs (1935), is first applied to a

number of alkali halides and periclase which have the sodium chloride structure, and reasonable agreement with the measured pressure derivatives is obtained. When applied to the spinel structure, the theory predicts that dc_{44}/dP is positive at low pressure but becomes negative at pressures of a few hundred kilobars. The geophysical implications of a negative dc_{44}/dP for the spinel region of the mantle are discussed. — Author's summary

08864 **Sando, William J.** Corals, Chap. 6 *in* History of the Redwall Limestone of northern Arizona: Geol. Soc. America Mem. 114, p. 257-343, illus., tables, 1969.

More than 1200 specimens of corals were collected representing 23 species in 16 genera, which are described and illustrated. Although commonly fragmentary, most are well preserved and are tied to a well-defined physical stratigraphy. The Redwall corals are not easily compared with faunas from strata of the same age from elsewhere in North America. The Redwall species can be divided into three groups: those with Mississippi Valley affinities, Cordilleran species with Mississippi Valley affinities, and endemic Cordilleran species. Regional correlations show that most of the Redwall rocks are Osagian and Meramecian. Some paleoecological interpretations are made on about half of the material, based almost entirely on the nature of the enclosing limestone. — HRC

Sandusky, C. L. *See* Barr, Jim L. 01661

09112 **Sansores Manzanilla, E.; Girard Navarrete, R.** Bosquejo geológico de la Zona Norte [abs.]: Inst. Mexicano Petróleo Rev., v. 1, no. 3, p. 81, 1969.

Saunders, R. Stephen. *See* Smith, Norman D. 01540

08949 **Savage, J. C.** The mechanics of deep-focus faulting: Tectonophysics, v. 8, no. 2, p. 115-127, illus., 1969.

In global tectonics the lithosphere slab, flawed by normal faults formed near oceanic trenches, is convected down into the mantle to form the seismic zone for deep-focus earthquakes. The dominant stress at depth is shear stress exerted along the slab length. This implies that about half of the old faults will be oriented about perpendicular to the axis of least compressive stress, forming favorable sites for fluid intrusion. As the outer face of the down-warped lithosphere is a region where partial melting is to be expected, melt will be intruded into those faults to form a sequence of lubricated planes available for deep-focus faulting. Faulting is initiated by 'slipping off' (possibly creep activated) of contact points between the two fault faces. Fault-plane solutions should yield P-axes aligned with dip of the seismic zone and T-axes perpendicular to the zone, although circumstances where axes are interchanged can arise. — *from* Author's abstract

Savage, J. C. *See* Kanasewich, E. R. 09015

01827 **Savage, James C.; Burford, Robert O.** Strain accumulation near Cholame, California, from 1932 to 1962 [abs.]: EOS, v. 51, no. 4, p. 427, 1970.

Savage, W. U. *See* Boucher, Gary W. 01626

01732 **Savin, Samuel M.; Epstein, Samuel.** The oxygen isotopic compositions of coarse grained sedimentary rocks and minerals: Geochim. et Cosmochim. Acta, v. 34, no. 3, p. 323-329, tables, 1970.

O-18/O-16 ratios of authigenic minerals are generally ten to thirty permil greater than those of detrital minerals of high temperature origin; thus isotopic compositions can be used to distinguish between the two. Isotopic compositions of authigenic or secondary minerals can be used to place limits on the conditions of their formation. Isotopic compositions of detrital minerals can be used as indicators of their provenance. — Authors' abstract

01633 **Savino, John; Sykes, Lynn R.; Liebermann, Robert C.; Murphy, Andrew; Kelleher, John.** Tectonic strain release by the underground nuclear explosions JORUM and MILROW [abs.]: EOS, v. 51, no. 3, p. 204, 1970.

Sawdo, Richard M. *See* Simon, Ivan. 01868

01828 **Saxena, Surendra K.; Ghose, Subrata.** Mg-Fe distribution isotherms at 500 and 800°C in orthopyroxenes [abs.]: EOS, v. 51, no. 4, p. 436, 1970.

01829 **Sayles, Fred L.** Crystallization of magnesite and dolomite [abs.]: EOS, v. 51, no. 4, p. 452, 1970.

Sayre, William W. *See* Jobson, Harvey E. 01610

Schaeffer, O. A. *See* Turekian, K. K. 01700

01579 **Schau, Mikkel Paul.** Geology of the Upper Triassic Nicola Group in south central British Columbia [abs.]: Dissert. Abs. Internat., Sec. B, Sci. and Eng., v. 30, no. 9, p. 4210B, 1970.

Schlue, J. W. *See* Knopoff, L. 08992

09074 **Schmidt, Victor A.** Paleomagnetism of primordial cave sediments — A promising new technique for the dating of caves [abs.]: Natl. Speleol. Soc. Bull., v. 31, no. 2, p. 41, 1969.

01635 **Schneider, H.; Gelpi, E.; Bennett, E. O.; Oro, J.** Fatty acids of geochemical significance in microscopic algae: Phytochemistry, v. 9, no. 3, p. 613-617, tables, 1970.

Fatty acids ranging from 14:0 to 18:4 were found in 11 species of blue-green and green algae, living counterparts of algae found in Precambrian and Tertiary sediments; the same species have been analyzed for hydrocarbons (Gelpi, ibid., p. 603-612, 1970). In general unsaturated C18 acids predominate in green algae and saturated C16 predominate in blue-green. No direct correlation is apparent between fatty acids and hydrocarbons within the same species. The fatty acids are distributed in a narrower molecular weight range than the hydrocarbons and do not show significant qualitative variations between species. Correlation of algal fatty acids with normal fatty acids in sediments, though valid in the C12-C20 range, is less apparent than that of the hydrocarbons; absence of unsaturated acids in sediments as opposed to abundance in living algae may be explained by low stability in a reducing geological environment. — VMJ

Schneider, H. *See* Gelpi, E. 01683

01592 **Scholl, David W.; Marlow, Michael S.** Diapirs and diapirlike structures, southeastern Bering Sea [abs.]: Am. Assoc. Petroleum Geologists Bull., v. 54, no. 3, p. 555-556, 1970.

01439 **Scholz, C. H.** Comments on paper by J. C. Savage and B. B. Mohanty, 'Does creep cause fracture in brittle rocks?' [1969]: Jour. Geophys. Research, v. 75, no. 11, p. 2148-2150, illus., 1970.

Savage and Mohanty [ibid., v. 74, no. 17, p. 4329-4332, 1969] concluded that 'creep' occurs in brittle rock and produces microfractures. Scholz infers that by 'creep' they are referring to some sort of thermally activated dislocation process, and since such a process has never been demonstrated to occur under these conditions, their conclusions would be of great importance if correct. However, Scholz does not agree with either their interpretation of the experimental results or with their conclusion, since their argument that the drop of w at high stress indicates that microfractures relieve internal strain is invalid. Rather, the drop in w is a spurious result of the formation of the fault in the specimen. — GV

01830 **Scholz, C. H.; Fitch, T.** Strain and creep in central California [abs.]: EOS, v. 51, no. 4, p. 427, 1970.

01831 **Scholz, C. H.; Page, Robert.** Buckling in island arcs [abs.]: EOS, v. 51, no. 4, p. 429, 1970.

01724 **Schröder, Gert.** Lagerstätten nutzbarer Minerale im Staat Oaxaca, Mexico: Erzmetall, v. 23, no. 2, p. 58-64, illus., 1970.

The visited [mineral] occurrences appear to be about half to at most two thirds of those suspected altogether in Oaxaca. Investigations indicate estimated reserves of about 1.5 million tons of workable silver ore (Totolapan District) with over 350 grams of Ag and 5 of Au per ton, as well as about 2.5 million tons of copper ore in veins with over 2 percent Cu and varied contents of silver. Near the silver ore, additional large occurrences are not likely; near the copper ore, there is possible existance of still undiscovered impregnated deposits on the Isthmus [of Tehuantepec]. As for nonmetallic minerals, 5 million cubic meters of white marble was detected. — Author's abstract, GDC

Schubert, Carl. *See* Bonatti, Enrico. 01694

Schwab, F. A. *See* Knopoff, L. 08992

01542 **Schwab, Frederic L.** Origin of the Antietam Formation (Late Precambrian,-Lower Cambrian), central Virginia: Jour. Sed. Petrology, v. 40, no. 1, p. 354-366, illus., tables, 1970.

In central Virginia, the Antietam consists principally of orthoquartzitic and protoquartzitic sandstone. Recrystallization and pressure solution often obscure original texture and sedimentary structures to produce quartzite. The Antietam was derived from a low-lying complex of intermixed crystalline rocks (schist, gneiss, and silicious plutons) and pre-existing sediments exposed west of the outcrop belt in the craton. Paleocurrent analysis (based principally on rarely occurring crossbedding) shows primary dispersal by marine bottom currents flowing down a paleoslope from northwest to southeast. Reworking by longshore currents (flowing northeast to southwest) contributed little or no additional volume of sediment. No southeastern borderland source (Appalachia?) is indicated.—*from* Author's abstract

01832 **Schwartzman, David W.** Possible primordial Ar-36 in Stillwater pyroxenes [abs.]: EOS, v. 51, no. 4, p. 449, 1970.

Sclater, J. G. *See* Francheteau, Jean. 01445

Scoffin, Terence P. *See* Neumann, A. Conrad. 01538

01655 **Scoffin, Terence P.** The trapping and binding of subtidal carbonate sediments by marine vegetation in Bimini lagoon, Bahamas: Jour. Sed. Petrology, v. 40, no. 1, p. 249-273, illus., 1970.

[The influence of various plant types on sedimentation is described.] Algal mats trap sediments chiefly by adhesion of grains to the sticky filaments. Their ability to resist erosion by unidirectional currents varies considerably depending upon mat type, smoothness of surface, and continuity of the cover. The intact areas of dense *Enteromorpha* mat can withstand currents five times stronger than those that erode loose unbound sand grains. Premature erosion of mats by currents occurs at breaks in the mat surface caused by the burrowing or browsing action of animals. Algal mats were found to be ephemeral and do not build up thick sediments as do dense grass and mangrove. The distribution of many plants in the lagoon is directly or indirectly controlled by the depth to bedrock; for example, mangroves on bedrock highs, marine grass in sediment-filled depressions. —*from* Author's abstract

Scott, C. H. *See* Culbertson, J. K. 01492

01556 **Scott, Glenn R.; Lindvall, Robert M.** Geology of new occurrences of Pleistocene bisons and peccaries in Colorado, *in* Geological Survey research 1970, Chap. B: U.S. Geol. Survey Prof. Paper 700-B, p. B141-B149, illus., 1970.

New occurrences of Quaternary mammals in Colorado, including *Bison* (*Gigantobison*)*latifrons* in Slocum Alluvium of Sangamon age; *Bison* (*Simobison*)? *alleni*? in Louviers Alluvium of early Bull Lake age; and *Platygonus compressus* in eolian sand of Pinedale and early Holocene age, permit a more definite assignment of age to these vertebrate species than has been possible in the past. — Authors' abstract

Scott, J. S. *See* Hobson, George D. 01457

01485 **Seaburn, G. E.** Preliminary analysis of rate of movement of storm runoff through the zone of aeration beneath a recharge basin on Long Island, New York, *in* Geological Survey research 1970, Chap. B: U.S. Geol. Survey Prof. Paper 700-B, p. B196-B198, illus., table, 1970.

A study of recharge basins on Long Island has provided information on the rate of movement of water through the zone of aeration. Pertinent data were collected during 38 storms from a basin in central Nassau County, where the depth to the water table is 35 feet below the bottom of the basin. In this basin the apparent downward rate of movement averaged 5.0 feet per hour; it ranged from an average of 3.0 feet per hour for storms in November through March to an average of 6.0 feet per hour for storms in April through October. — Author's abstract

01503 **Seager, William R.** Low-angle gravity glide structures in the Northern Virgin Mountains, Nevada and Arizona: Geol. Soc. America Bull., v. 81, no. 5, p. 1517-1538, illus., table, 1970.

The Northern Virgin Mountains of northwestern Arizona and adjacent Nevada consist of a core of Precambrian metamorphic rocks flanked by marine Paleozoic rocks. Mesozoic and Tertiary rocks largely continental clastics, previously unknown in northwestern Arizona, are also present. Three major fault bounded uplifts, guided at least in part by Precambrian structures, were topographic highs from which large plates of rock glided under the influence of gravity. The earliest uplift and related gliding took place during the Laramide orogeny, the others during the Tertiary. The Laramide gliding is characterized by a sharp glide surface and tight drag folding, which suggests plastic flow under considerable cover. Brecciation and minor folding associated with the Tertiary gliding suggests gliding under less cover. — WHN

08928 **Seegmiller, B. L.; Wilson, J. E.** An instrument to determine uniaxial stress in short columns [abs.]: Mining Eng., v. 21, no. 12, p. 59, 1969.

08884 **Seigel, Harold O.** Geophysical exploration in the Pine Point area [abs.]: Geophysics, v. 34, no. 6, p. 1019, 1969.

01511 **Sen Gupta, Joy G.** Rapid combustion methods for determining sulfur in rocks, ores and stony meteorites — A comparative study of the usefulness of resistance-type and induction furnaces [with French and German abs.]: Anal. Chim. Acta, v. 49, no. 3, p. 519-525, tables, 1970.

A satisfactory procedure for determining total sulfur in rocks, ores and stony meteorites with a Leco induction furnace is described. Suitable fluxes, time for complete evolution of sulfur dioxide, and suitable absorption solutions for sulfur dioxide are discussed. A comparative study of three different combustion methods for determining sulfur in a variety of geological materials has also been made. The results indicate that induction heating is superior to resistance heating for most samples containing up to 20 percent total sulfur. — Author's summary

09019 **Shankland, T. J.** Transport properties of olivines, *in* The application of modern physics to the earth and planetary interiors (S. K. Runcorn, editor): London and New York, Wiley-Interscience, p. 175-190, illus., tables, 1969.

Effects are discussed of iron as an impurity in a silicate lattice to emphasize similarity of silicates to other oxides and to demonstrate dominance by transition-metal ions (principally iron) of electrical and optical properties of materials probably constituting the mantle. Studies of absorption spectra of forsterite show that lower energy

levels in olivines are due to impurities, mainly iron, which give rise to the electric properties of interest in solid earth geophysics; the most direct application is to thermal conductivity of radiative transport. Experimental studies have shown that since pure forsterite is an excellent insulator, electrical conduction in olivine will be due to iron which substitutes for magnesium in the lattice. Conduction theories of well-behaved semiconductors should be put aside, and the field of low-mobility semiconductors should be examined more intensively. — VSN

01421 **Sharma, G. D.; Burrell, D. C.** Sedimentary environment and sediments of Cook Inlet, Alaska: Am. Assoc. Petroleum Geologists Bull., v. 54, no. 4, p. 647-654, illus., table, 1970.

Unique gross morphologic and climatologic factors appear to be important in this distinctive south-central Alaska environment. Sediments are predominantly cobbles, pebbles, and sand with minor admixtures of silt- and clay-size material. Three sedimentary facies are suggested on the basis of grain-size distribution; their boundaries are well defined. During summers, glacially-derived sediment is added to the upper part of the inlet and strong currents transport silt and clay fractions seaward towards the Forelands morphologic constriction where tidal flushing removes almost all fine material. During winters, little sediment is added, and sediments are reworked mostly by ice-rafting. Much material is probably deposited initially adjacent to the Forelands. — *from* Authors' abstract

01553 **Sharp, Jonathan H.** Discussion of a paper by C. D. Gebelein [1969] entitled "Distribution, morphology, and accretion rate of recent subtidal algal stromatolites, Bermuda" [1969]: Jour. Sed. Petrology, v. 40, no. 1, p. 521, 1970.

The trapping of sediments by the algae, attributed to adhesive effects by Gebelein [ibid., v. 39, p. 49-69], is more likely the result of the baffling effects of multifilamentous algae. Studies also show that Gebelein has misinterpreted the roles of two algal species in trapping and binding sediment particles. — HRC

Sharp, R. P. *See* Shreve, R. L. 01497

01857 **Sharp, William N.** Extensive zeolitization associated with hot springs in central Colorado, *in* Geological Survey research 1970, Chap. B: U.S. Geol. Survey Prof. Paper 700-B, p. B14-B20, 1970.

Extensive zeolitization that accompanied formation of laumontite-leonhardite in shattered quartz monzonite at the base of Mount Princeton in central Colorado is attributed to hot silica- and calcium-bearing alkaline waters reacting with the country rock at depth. The shattered and altered rocks and active thermal springs are related to faults that are part of the upper Arkansas Valley structure system. Apparent zoning of mineral assemblages around the thermal centers seems similar to that in other thermal areas, and is significant in terms of depth of formation, temperature, and pressure. — Author's abstract

Sherman, F. B. *See* Cartwright, K. 08927

Shido, Fumiko. *See* Miyashiro, Akiho. 01642

01703 **Shive, Peter N.** Deformation and remanence in magnetite: Earth and Planetary Sci. Letters, v. 7, no. 5, p. 451-455, illus., table, 1970.

The effects of elastic and plastic deformation and fracturing on the remanent magnetic properties of ten magnetite samples were studied. Thermoremanence produced in a 10 Oe external field was only partly destroyed by hydrostatic compression, elastic strain and fracturing, but was almost completely destroyed by small plastic strain. Alternating field demagnetization shows that the coercivity spectrum of 10 Oe TRM produced before and after plastic strain is not significantly different. The high stresses required to produce plastic deformation make it unlikely that upper crustal nonmetamorphic rocks have been demagnetized by deformation. — *from* Author's abstract

09040 **Short, Nicholas M.** Shock metamorphism of basalt: Modern Geology, v. 1, no. 1, p. 81-95, illus., tables, 1969.

DANNY BOY event (1962) in andesite basalt, Nevada, produced a 66.5 m diameter crater of 19 m depth. Ejecta ranged from pebbles to blocks up to 5 m; most show no visible signs of shock damage. Rock adjacent to the cavity, although ruptured, experienced only moderate microfracturing of plagioclase and olivine. Along the crater lip, occasional ejecta appear strongly shocked; low-density masses of vesiculated basalt in which plagioclase crystals are destroyed retains vestiges of original texture and provides the only terrestrial analog to lunar rock fragments. This basalt is 60-70 percent andesine, olivine, augite, magnetite, and other phases. A technique for recognizing shock damage in lunar basalts and other fine-crystalline basic rocks is suggested. Composition of individual crystals is determined by microprobe analysis after refractive indices are carefully measured. If shocked, olivine (and other ferromagnesian minerals) should have anomalously low refractive indices values relative to unshocked equivalents. — *from* Author's abstract

01494 **Shown, Lynn M.** Evaluation of a method for estimating sediment yield, *in* Geological Survey research 1970, Chap. B: U.S. Geol. Survey Prof. Paper 700-B, p. B245-B249, illus., tables, 1970.

A method for estimating annual sediment yield, developed by the Pacific Southwest Inter-Agency Committee, was tested in 28 small watersheds ranging in size from 0.02 to 37 square miles. These watersheds for which hydrologic records exist are in arid and semiarid areas of western Colorado, north-central New Mexico, and east-central Wyoming, and represent a variety of geologic, climatic, ecologic, and topographic conditions. Estimates of sediment yield correlated closely with sediment yields measured in reservoirs, but the estimates were usually lower than the measured yields. The method was designed to make general sediment classifications for areas greater than 10 square miles, but it also appears to work nearly as well for watersheds that are as small as 0.1 square mile. — Author's abstract

01497 **Shreve, R. L.; Sharp, R. P.** Internal deformation and thermal anomalies in lower Blue Glacier, Mount Olympus, Washington, U.S.A. [with French and German abs.]: Jour. Glaciology, v. 9, no. 55, p. 65-86, illus., tables, 1970.

Annual inclinometer surveys, from 1957-62 in six drill holes in lower Blue Glacier, investigated the deformation field and flow laws of the ice at depth. Measurements were seriously hampered by freezing at depth; possible reasons are discussed. Observations of motions of the pipe lining holes give only the two components of velocity perpendicular to the hole. Thus, a single hole gives two independent equations connecting the 9 unknown derivatives of velocity components, two holes give four equations, and three or more give six. Incompressibility of ice gives another; remaining unknowns must be neglected or estimated. Longitudinal strain-rate is less than about 0.01 per yr. Effective strain-rates are only about 0.01 to 0.1 per yr, in reasonable agreement with flow laws deduced by Glen, Nye, and Paterson and Savage, except that viscosities for Blue Glacier are about half those of other studies. — VSN

Siebert, Robert M. *See* Hostetler, Paul B. 01783

01586 **Silver, Eli Alfred.** Structure of the continental margin off northern California, north of the Gorda Escarpment [abs.]: Dissert. Abs. Internat., Sec. B, Sci. and Eng., v. 30, no. 9, p. 4284B, 1970.

Silver, L. T. *See* McGetchin, T. R. 01799

Simmons, G. *See* VonHerzen, R. P. 01496

Simmons, Gene. *See* Combs, Jim. 01750

01868 **Simon, Ivan; Sawdo, Richard M.; Sáenz R., Rodrigo; Melson, William G.** Preliminary results from tiltmeter recording at Arenal Volcano, Costa Rica [abs.]: EOS, v. 51, no. 4, p. 440, 1970.

01560 **Sims, John D.** Authigenic kaolinite in sand of the Wilcox Formation, Jackson Purchase region, Kentucky, *in* Geological Survey research 1970, Chap. B: U.S. Geol. Survey Prof. Paper 700-B, p. B27-B32, illus., table, 1970.

Authigenic kaolinite occurs as spindle-shaped rods and subhedral vermicular masses in the Wilcox Formation of Eocene age in Kentucky. The vermicular kaolinite occurs in sand and silt having "sawdust sand" lithology. Lack of disruption or abrasion of the delicate spindle-shaped rods and vermicular masses indicates that the kaolinite is of diagenetic rather than detrital origin. The sediments of the Wilcox Formation are dominantly of fluvial origin derived by erosion and alteration of local detritus from underlying rocks. Thermodynamic considerations suggest postdepositional flushing with fresh water during which preexisting phyllosilicate minerals were altered to kaolinite and an illite-like mineral. — Author's abstract

01833 **Sinha, A. K.; Davis, T. E.** Isotopic composition of lead from Franciscan rocks [abs.]: EOS, v. 51, no. 4, p. 445, 1970.

09115 **Sinotte, Stephen R.** The fabulous Keokuk geodes — V. 1, Their origin, formation and development in the Mississippian lower Warsaw beds of southeast Iowa and adjacent states: Des Moines, Iowa, Wallace-Homestead Co., 292 p., illus., 1969.

Nearly all Keokuk geodes are found within a 70-mi radius of Keokuk (southeastern Iowa, west-central Illinois, northeastern Missouri); they are noteworthy for their abundance and the variety of their mineral inclusions and crystal formations. Following an introduction, the sections of the book are entitled: occurrence of Keokuk geodes — their stratigraphic, geographic, and lithologic distribution; origin of Keokuk geodes and their concretion progenitors — the Hayes theory; principal classifications of geodes in the upper Keokuk and lower Warsaw Formations; diagenetic shell and epigenetic cavity formation of S-type, C-type and SC-type geodes from calcareous concretions, and related primary mineral segregation; development of geodes — secondary mineral paragenesis; and crystallography and mineralogy of geode mineral inclusions. Appendices contain color plates and analyses of selected geodes, and principal collecting sites; a glossary and bibliography are included. — MCM

Siple, G. E. *See* Stock, G. W., Jr. 08998

Skinner, Brian J. *See* Petrović, Radomir. 01814

08994 **Skinner, Brian J.** Earth resources: Englewood Cliffs, N.J., Prentice-Hall (Found. Earth Sci. Ser.), 150 p., illus., tables, 1969.

This introductory text can be used to supplement and enrich other textbooks, allowing the teacher great flexibility in course arrangement and presentation. Chapter headings are: what constitutes an earth resource?; abundance and availability of earth's resources; metals, the abundant elements; metals, the scarce elements; industrial minerals, chemical and fertilizer supplies; industrial rocks, the building materials; energy, the saga of the fossil fuels; and water. The appendix contains a table of chemical elements and their crustal abundances, and tables of principal ore minerals and annual world production rate (1967). Suggestions for further reading and an index are included. — MCM

01475 **Skipp, Betty; Mamet, B. L.** Stratigraphic micropaleontology of the type locality of the White Knob Limestone (Mississippian), Custer County, Idaho, *in* Geological Survey research 1970, Chap. B: U.S. Geol. Survey Prof. Paper 700-B, p. B118-B123, illus., 1970.

Restudy of interbedded limestone, conglomerate, and sandstone of the White Knob Limestone at its type locality near Cabin Creek has shown the entire sequence has a minimum thickness of 5,500 feet and is of Visean and early Namurian age. Foraminiferal Zones 16_1 through 18 are identified with certainty; beds below Zone 16_1 are at least as young as Zone 13. Chert and quartzite pebble conglomerates present in Zones 16, and 17 represent orogenic pulses of the same age as some pulses

recorded by conglomerates of the Diamond Peak Formation, east-central Nevada. The type White Knob is the time-stratigraphic equivalent of Huh's (1967) Middle Canyon, Scott Peak, and South Creek Formations and part of his Surrett Canyon Formation, south-central Idaho, and the equivalent of the Chesterfield Range Group of southeastern Idaho; it is also equivalent to parts of the Mount Head and Etherington Formations of southwestern Alberta. — *from* Authors' abstract

08921 **Skipp, Betty.** Foraminifera, Chap. 5 *in* History of the Redwall Limestone of northern Arizona: Geol. Soc. America Mem. 114, p. 173-256, illus., 1969.

One or more representatives of Endothyridae, Earlandiidae, Paleotextulariidae, Cornuspiridae, and Parathuramminidae occur in the Redwall Limestone. Endothyroids are most numerous with 7 genera and more than 40 species. Six zones, from bottom to top are the: *Septaglomospiranella, Tuberendothyra paratumula, T. tuberculata, Endothyra spinosa* assemblage zones, and the *Eomillerella spiroides* and *E. scitula* range zones. A picture of endothyroid phylogeny is presented, and well-developed evolutionary trends in other calcareous foraminifera are shown, especially in the transgressive phase rocks of the Redwall. All the forms are described and illustrated. — HRC

09036 **Slansky, Cyril M.; Buckham, James A.** Ultimate management of radioactive liquid wastes, *in* Water, 1969 (L. K. Cecil, editor) — Chem. Eng. Prog. Symposium Ser., No. 97, V. 65: New York, Am. Inst. Chem. Engineers, p. 26-31, illus., table, 1969.

Ultimate disposal of high-level radioactive wastes may involve nuclear transmutation to inert isotopes or extreme isolation such as transmission to the sun, storage in deep reservoirs produced by nuclear explosives, or in the ocean depths. These approaches are discussed along with a minimum of additives. — Authors' abstract

01834 **Sleep, Norman H.** Thermal effects of the formation of Atlantic continental margins by continental break-up [abs.]: EOS, v. 51, no. 4, p. 429, 1970.

01491 **Sloan, C. E.** Prairie potholes and the water table, *in* Geological Survey research 1970, Chap. B: U.S. Geol. Survey Prof. Paper 700-B, p. B227-B231, illus., table, 1970.

Prairie potholes, or sloughs, are water-holding depressions of glacial origin that occur in prairies of the northern conterminous U.S. and southern Canada. The water table in the prairie-pothole region is a shallow surface that is a subdued image of the general topography. In detail small variations in topography are not reflected, and in cross sections the water table is almost a straight line linking pothole water surfaces. Salinity and permanence of contained water differ widely among potholes and are influenced by ground-water flow which is partially dependent on configuration of the water table surrounding the pothole. Ground-water inflow, throughflow, and outflow result when the adjacent water table is correspondingly high, intermediate, and low. Relative permanence and salinity increase or decrease as net ground-water movement ranges from inflow to outflow. — *from* Author's abstract

01639 **Sloss, L. L.** Illinois basin has deep gas and oil potential: World Oil, v. 170, no. 6, p. 95-97, illus., 1970.

Possible deep hydrocarbon production is drawing attention to the Illinois basin. Some 10,000 feet of virtually unexplored deep deposits, similar to those in other productive areas, plus proximity to areas of high energy demand make the area particularly attractive. — Author's abstract

01583 **Small, William David.** Cordilleran geochronology deduced from hydrothermal leads [abs.]: Dissert. Abs. Internat., Sec. B, Sci. and Eng., v. 30, no. 9, p. 4212B-4213B, 1970.

01502 **Smalley, Ian J.; Cabrera, José G.** The shape and surface texture of loess particles: Geol. Soc. America Bull., v. 81, no. 5, p. 1591-1595, illus., 1970.

Samples of loess from Nebraska and Karlsruhe have been examined by scanning electron microscope. This has revealed that particles from both deposits have very fine (about 1μ) particles adhering firmly to them. This was also observed in an artificial sample of finely ground quartz sand. It is suggested that the fine particles are comminution debris and that their presence points strongly to the loess quartz particles being formed by glacial grinding. Calcium carbonate appeared to form discrete overgrowths on the Karlsruhe particles rather than existing as a complete coating on the quartz grains. Some surface textures were observed on Nebraska grains which were very similar to those observed on desert sand grains. — Authors' abstract

Smith, A. L. *See* Peterman, Zell E. 01698

09070 **Smith, A. Richard.** Gypsum karst, Eddy County, New Mexico and Culberson County, Texas [abs.]: Natl. Speleol. Soc. Bull., v. 31, no. 2, p. 39, 1969.

09079 **Smith, A. Richard.** Cave and karst regions of Texas [abs.]: Natl. Speleol. Soc. Bull., v. 31, no. 2, p. 46, 1969.

Smith, C. R. *See* Gurk, H. M. 09094

08900 **Smith, D. I.** The solutional erosion of limestone in the area around Maldon and Maroon Town, St. James, Jamaica, *in* Limestone geomorphology, a study in Jamaica: Cave Sci., v. 6, nos. 43-44, p. 120-135, illus., tables, 1969.

For 1500 water samples from limestone catchment areas, feeder streams, outflows and sinks, Ca and Mg hardness values are related to suggested roles of factors controlling processes of solution. Particularly constant is Ca to Mg ratio. For comparison, in a calculated annual solution erosion rate, the major controlling variable is effective runoff; neither water hardness values nor solution processes seem to differ much from those of temperate latitudes and climates. In various limestone lithologies within Jamaica, cockpit landforms are associated only with the White Limestone; rates of solution there differ little from those of other lithologies in areas of no cockpit terrain. Origin of cockpits, generally considered tropical features, may be related to hydrologic characteristics conditioned by structural properties of limestones, dominantly jointing. — GDC

08989 **Smith, D. I.** (leader). Limestone geomorphology, a study in Jamaica — University of Bristol Karst Hydrology Expedition to Jamaica, 1967: Cave Sci., v. 6, nos. 43-44, 166 p., illus., tables, 1969.

Jamaica was chosen for this study in order to assess possible variations in limestone solutional erosion under a humid tropical climate, in comparison with limestone erosion in other climatic regimes. All members of the expedition in their varying fields were struck more by the similarities between tropical and temperate limestone geomorphology than by the differences. Six of the papers are cited separately in this bibliography, two by T. C. Atkinson, the others by D. P. Drew, D. I. Smith, F. H. and H. M. Nicholson, and C. High and F. K. Hanna. — GDC

Smith, D. K. *See* Borg, I. Y. 09020

Smith, Douglas. *See* Lindsley, D. H. 01795

01835 **Smith, Douglas.** Stability of Fe-rich, Ca-poor pyroxene [abs.]: EOS, v. 51, no. 4, p. 435, 1970.

01676 **Smith, J. V.; Mason, Brian.** Pyroxene-garnet transformation in Coorara meteorite: Science, v. 168, no. 3933, p. 832-833, tables, 1970.

Majorite is a new garnet in a veinlet of the Coorara meteorite. Its chemical composition is compatible with derivation mostly from original pyroxene, not from olivine as originally reported. Silicon is partly in sixfold coordination. Ringwoodite, a spinel of olivine composition, occurs as purple grains set in a matrix of fine-grained garnet. The similar mineralogy and texture of the Coorara and Tenham meteorites suggest a common parent body. — Authors' abstract

01540 **Smith, Norman D.; Saunders, R. Stephen.** Paleoenvironments and their control of acritarch distribution — Silurian of east-central Pennsylvania: Jour. Sed. Petrology, v. 40, no. 1, p. 324-333, illus., table, 1970.

Four environments are recognized: open marine, barrier bar, tidal flat-lagoonal (all in the Clinton), and fluviatile (Tuscarora-Shawangunk). The acritarchs are confined to depositional areas continuously or intermittently open to marine waters and do not occur in the fluvial deposits; the degree of preservation reflects the depositional environment — forms from deeper open marine sediments are generally well preserved, while those in the near-shore transitional facies are usually fragmentary and abraded. Acritarch distribution is in part controlled by directions of prevailing currents. These relations suggest that acritarchs might be exploited more by sedimentary geologists in reconstructing ancient depositional environments. — *from* Authors' abstract

01500 **Smith, Patsy B.** New evidence for a Pliocene marine embayment along the lower Colorado River area, California and Arizona: Geol. Soc. America Bull., v. 81, no. 5, p. 1411-1420, illus., table, 1970.

Marine foraminiferal, marine to fresh-water molluscan, and brackish- to fresh-water ostracode faunas occur in a thick section of the Bouse Formation along the Colorado River from Parker to Yuma. The presence of marine Foraminifera, including *Globigerina* sp., is considered evidence that the area was continuously connected with the ocean. Similar sediments are found in the subsurface near Yuma and contain faunas which at shallow depths are similar to those to the north, but at greater depths contain bathyal assemblages with an abundance of globigerinids, which indicate a post-Miocene age for the section, and oceanic conditions. This marine embayment probably extended into the Imperial Valley, where the Imperial Formation of probable Pliocene age also contains marine faunas. Evidence strongly indicates a Pliocene marine embayment along the lower Colorado River, connected with the Imperial Valley. — *from* Author's abstract

Smith, Preston C. *See* Blystone, Jerome R. 09058

01625 **Smith, Stewart W.; Archambeau, Charles B.** Tectonic strain readjustments as a result of a large underground explosion [abs.]: EOS, v. 51, no. 3, p. 203, 1970.

09118 **Smith, Stewart W.** Fault creep, earthquakes, and strain release in California [abs.]: EOS (Am. Geophys. Union Trans.), v. 50, no. 5, p. 384-385, 1969.

08936 **Smith, Terrence J.** Foundation curtain grouting evaluated with unit take concept: Assoc. Eng. Geologists Bull., v. 5, no. 2, p. 137-154, illus., tables, 1968 [1969].

New Poe Lock on St. Marys River, which flows from Lake Superior to Lake Huron, was constructed at Sault Ste. Marie, Mich., on the Jacobsville Formation of Cambrian age. The rock foundation was grouted in a 1,000-ft-long curtain of 150 holes, to reduce seepage and uplift during winter months. A decrease with each consecutive grout was indicated. Subsequent drain-hole observations proved the curtain grout effective; the data will be useful for estimating grouting quantities and evaluating effectiveness of curtain grouting for other locks where geologic conditions are similar to the jointed sandstones here described. Partings, less than an inch apart in shaly sandstone and commonly 2 to 3 feet apart in hard beds, are filled with clay and silt. — GDC

Snipes, David S. *See* Goforth, Thomas M. 08932

09004 **Snow, David T.** Discussion of reservoir leakage (with replies [by H. A. Coombs, G. D. Roberts, C. J. Monahan, D. W. Carpenter, B. C. Moneymaker, W. I. Gardner, and A. S. Cary]), *in* Reservoir leakage and groundwater control: Assoc. Eng. Geologists Bull., v. 6, no. 1, p. 83-94, 1969.

The author clarifies certain points made in papers submitted to the symposium and suggests further directions for study. The present symposium demonstrated that leakage, its analysis and rectification, can be adequately handled with existing techniques or experience, partly because water losses amount to failure in degree.

Related problems of foundation deterioration or stability are less adequately understood, less amenable to analytical solution, and of greater importance because such failures tend to be absolute or catastrophic. Snow suggests a sequel symposium on the effects of pore-pressure distribution and foundation deterioration during seepage. Piping and interplay between ground-water hydrology and rock mechanics are two problems of great importance. Replies of authors of the papers are included. — EH

01535 **Solohub, J. T.; Klovan, J. E.** Evaluation of grain-size parameters in lacustrine environments: Jour. Sed. Petrology, v. 40, no. 1, p. 81-101, illus., 1970.

Using an area of recent lacustrine sedimentation as a reference model, several methods of treating grain-size distribution of sands were evaluated for their ability to discriminate between, or identify, depositional environments. Techniques of Passega, Mason and Folk, Friedman, Sahu, and Klovan were applied. When analyzed as though from unknown environments, none of the methods could reliably identify the true depositional environments. Only factor analysis (Klovan, 1966) produced mappable results consistent with known energy conditions at depositional sites. The hypothesis that grain-size distributions can identify depositional environments is probably not universally valid. It is concluded that grain-size distributions reflect depositional processes rather than environment and that the two need not be the same. — *from* Authors' abstract

Somerville, M. R. *See* Bolt, Bruce A. 01679

01551 **Southard, John B.** Impossibility of Bernoulli pressure forces on particles suspended in boundary layers — Discussion of a paper by R. V. Fisher and J. M. Mattinson [1968]: Jour. Sed. Petrology, v. 40, no. 1, p. 518-519, illus., 1970.

Mathematical evidence is presented to show that the Bernoulli boundary-layer effect, as postulated by Fisher and Mattinson (ibid., v. 38, p. 1013-1023, 1968), is not possible. The Bernoulli equation cannot be applied to rotational flows of real fluids in which the pressure in fact varies hydrostatically in the direction normal to the boundary. — HRC

01666 **Speidel, David H.** Effect of magnesium on the iron-titanium oxides: Am. Jour. Sci., v. 268, no. 4, p. 341-353, illus., tables, 1970.

Phase relations between coexisting rhombohedral (hematite, etc.) and spinel (magnetite, etc.) phases in the system MgO-FeO-Fe_2O_3-TiO_2 at temperatures of 1300° and 1160°C and fugacities of oxygen between $10^{-3.4}$ and $10^{-10.7}$ atm. indicate: (A) that the amount of rhombohedral phase dissolved in the spinel phase decreases with increasing MgO-content; (B) that the oxygen fugacities predicted from the Fe-Ti contents of coexisting oxides are an order of magnitude too low if Mg is also present in the oxides; (C) that the calculation of Mg as $MgTiO_3$ and Mg_2TiO_4 minimizes the error produced in (B) (Anderson, 1968); and (D) that with increasing MgO-contents at moderately high oxygen fugacities ($> 10^{-9}$) the rhombohedral phase decomposes to a spinel phase and a pseudobrookite phase. — Author's abstract

Spencer, D. W. *See* Brewer, P. G. 01640

01444 **Spetzler, Hartmut.** Equation of state of polycrystalline and single-crystal MgO to 8 kilobars and 800°K: Jour. Geophys. Research, v. 75, no. 11, p. 2073-2087, illus., tables, 1970.

The elastic constants of polycrystalline and single-crystal MgO were measured in a gas high-pressure system over a temperature range from 300°K to the Debye temperature of MgO. Data from the polycrystalline specimen indicated large effects of temperature on the pressure derivatives. These data did not agree with the results obtained from single-crystal measurements. Upon remeasuring the ceramic sample it becomes apparent that the data are not reproducible after the sample has been cycled to high temperature and pressure. Additional sintering, deformation of the individual grains, and recrystallization take place, which change the properties of the

sample. These problems and the problems of sintering isotropic aggregates of theoretical density limit the usefulness of this widely used procedure. — *from* Author's abstract

Spinner, E. *See* Moore, L. R. 08946

01522 **Squarer, David.** Friction factors and bed forms in fluvial channels: Am. Soc. Civil Engineers Proc., v. 96, paper 7245, Jour. Hydraulics Div., no. HY 4, p. 995-1017, illus., tables, 1970.

Bed-form geometry in a curved channel and a straight flume which are subject to the same nominal flow conditions is investigated by statistical analysis of records of stream bed profiles. A quantitative comparison between bed geometry in curved and straight channels is made in terms of the autocorrelation, spectral density and probability density function of a process defined by the bed elevation. The same statistical functions are used to evaluate the bed-friction factor and ripple celerities. It has been found from experiments that the total rate of sediment transport in the curved channel is approximately 15 times as much as that of a straight flume which is subject to nominally identical flow conditions. — ASCE abstract

01836 **Srinivasan, R.; Alexander, E. C., Jr.** Xenon in tellurium and cesium minerals [abs.]: EOS, v. 51, no. 4, p. 454, 1970.

08851 **Stanley, Daniel J.** (editor). The new concepts of continental margin sedimentation, application to the geological record — AGI short course lecture notes, Philadelphia, 1969: Washington, D. C., Am. Geol. Inst., sections paged separately, illus., 1969.

This short course contains an introduction, 2 lectures on coastal sedimentation, 4 on shelf sedimentation, 4 on slope and base-of-slope sedimentation, and 2 on continental margin structure, sedimentation, and paleogeography; each is cited separately. No claim is made that the lectures are complete, but they do cover some of the more recent and significant work in this area of marine geology and sedimentary petrology. Hopefully, the volume will prove useful as a teaching aid and desk reference. — HRC

08855 **Stanley, Daniel J.** Submarine channel deposits and their fossil analogs ('fluxoturbidites'), Lecture 9 *in* The new concepts of continental margin sedimentation, application to the geological record — AGI short course lecture notes, Philadelphia, 1969: Washington, D. C., Am. Geol. Inst., p. DJS9-1—DJS9-17, illus., 1969.

Channel deposits, coarse fills of submarine canyons and other valleys, are recognized as "shoestring" bodies that migrate downslope across hemipelagic and bottom-current transported units and turbidite bundles. Their fossil equivalents, answering the description of *fluxoturbidites*, are important paleogeographic indicators. These sedimentary fills of downslope "dispersal funnels" are well developed on lower slopes, subsea fans, and rises, and can be traced well into basins; they need not necessarily be proximal. Geometry and primary structures of submarine channel deposits indicate that traction-related processes are dominant in their formation. Examples from the northeastern North Atlantic Coastal Plain are cited. — HRC

08916 **Stanley, Daniel J.** (convener). Introduction to the course, Lecture 1 *in* The new concepts of continental margin sedimentation, application to the geological record — AGI short course lecture notes, Philadelphia, 1969: Washington, D. C., Am. Geol. Inst., p. DJSI-1—DJSI-7, 1969.

In view of advances made in other scientific disciplines during the 1960's, now is the appropriate time to examine new ideas developed in marine geology, especially sedimentation. Submerged continental areas form 1/8th of the Earth's surface. The sediments are the end products of much previous geologic activity, so their investigation has value in determining the past history of the material. Ground rules are sought in order to compare modern with past shelf sedimentation; the modern shelf is but a Pleistocene museum. How valid are some of our favorite tenets? This course is designed to provide opportunity to rake hallowed concepts — or those in current use — over the proverbial coals. A bibliography lists 39 monographs on marine sedimentation. — HRC

08920 **Stanley, Daniel J.** Sedimentation in slope and base-of-slope environments, Lecture 8 *in* The new concepts of continental margin sedimentation, application to the geological record — AGI short course lecture notes, Philadelphia, 1969: Washington, D. C., Am. Geol. Inst., p. DJS8-1—DJS8-25, illus., 1969.

Among criteria for recognizing slope and base-of-slope sedimentary environments in the geologic record are: thickness, lateral persistency, wedge shapes, channel deposits and fluxoturbidites, slump deposits, large gravity-slide deposits, proximal turbidites, distal turbidites, mudballs, constant current direction indicators, scour marks, tool marks, finely laminated hemipelagic sediments, major faunal breaks, bioturbate structures, and outcrops of earlier rocks. These occur on the slope with varying degrees of importance, and none is unique. Pebbly mudstone, however, seems to be a slope deposit indicator. — HRC

01689 **Stanton, Robert J., Jr.** Cyclicity in upper Tertiary basin-margin deposits of California Coast Ranges [abs.]: Am. Assoc. Petroleum Geologists Bull., v. 54, no. 3, p. 561, 1970.

01478 **Stefansson, Karl; Owens, James P.** Clay mineralogy of selected samples from the middle Miocene formations of southern Maryland, *in* Geological Survey research 1970, Chap. B: U.S. Geol. Survey Prof. Paper 700-B, p. B150-B156, illus., 1970.

The relative proportions of clay minerals in about 130 samples from the core of a 338-foot hole drilled by the Baltimore Gas and Electric Co. in Calvert County, Md., in 1967 were calculated from X-ray diffraction patterns, using the ratio of peak area over peak height. Kaolinite, illite, and montmorillonite constitute most of the clay fraction. The illite proportion is nearly constant throughout the core, but the proportions of montmorillonite and kaolinite vary. The results obtained substantiate the hypothesis that montmorillonite increases and kaolinite decreases seaward, away from the source area. — Authors' abstract

Steinman, Gary. *See* Kenyon, Dean H. 09017

08885 **Stemp, Robert W.** Airborne EM survey unveils unique Canadian copper deposits [abs.]: Geophysics, v. 34, no. 6, p. 1019, 1969.

Stepanov, I. S. *See* Gradusov, B. P. 09027

08998 **Stock, G. W., Jr.; Siple, G. E.** Ground-water records of South Carolina, 1966: South Carolina Div. Geology Misc. Rept. 5, 39 p., illus., tables, 1969.

The basic ground-water data collected in South Carolina during 1966 include records of water levels and chemical analyses of ground waters, both those representative of aquifers monitored by the observation wells and other water samples collected during the year. Progressive salt-water encroachment has not been detected in any of the principal aquifers. — MCM

Stoertz, George E. *See* Hemphill, William R. 09012

01837 **Stoiber, Richard E.; Rose, William I., Jr.** Geochemistry of Central American volcanic gas condensates [abs.]: EOS, v. 51, no. 4, p. 440, 1970.

Stonehouse, D. H. *See* Brady, J. G. 09052

01838 **Stormer, John C., Jr.** The free energy of sodalite and the fugacity of halogens in igneous rocks [abs.]: EOS, v. 51, no. 4, p. 434, 1970.

Storzer, D. *See* Wagner, G. A. 01846

01682 **Straka, Joseph John, 2d.** Age and correlation of the Goddard and Springer Formations in southern Oklahoma as determined by conodonts [abs.]: Dissert. Abs. Internat., Sec. B, Sci. and Eng., v. 30, no. 9, p. 4285B, 1970.

09032 **Strens, R. G. J.** The nature and geophysical importance of spin pairing in minerals of iron (II), *in* The application of modern physics to the earth and planetary interiors (S. K. Runcorn, editor): London and New York, Wiley-Interscience, p. 213-220, illus., 1969.

In 1966, Strens confirmed that high pressures would induce spin pairing in oxygen compounds of iron (II) by locating spin-state transition in gillespite. This paper considers conditions under which such transitions will occur by calculating the probable transition pressure at mantle temperatures, and by evaluating geophysical consequences. Results indicate that depending on phase involved, the spin-state transition should decrease volume of a system with Fe:Mg = 20:80 by 1 to 3 percent causing corresponding changes in volume-dependent physical properties. Thus, a minor seismic discontinuity would be expected at a depth of 1400 km in the Earth, although behavior might be complicated by postulated increase in mean atomic weight and by spin-state equilibrium. Discontinuities will also exist in magnetic susceptibility and electrical conductivity of iron (II) minerals at the transition pressure. — VSN

08999 **Stuart, W. Harold.** Introduction, *in* Reservoir leakage and groundwater control: Assoc. Eng. Geologists Bull., v. 6, no. 1, p. 1-2, 1969.

This symposium on reservoir leakage and ground-water control was held in Seattle at the 1968 national meeting of the Association of Engineering Geologists. Six papers and a discussion (cited separately) cover the design of leakage control systems and information on unconsolidated and consolidated foundation and abutment materials. The author in his introduction cites the responsibilities of geologists in helping to prevent dam failures, as well as economic and public-relations aspects of reservoir leakage. — EH

Studer, H. P. *See* McLaughlin, W. A. 01801

09102 **Stumm, Erwin C.; Chilman, Ruth B.** Phyllocarid crustaceans from the Middle Devonian Silica Shale of northwestern Ohio and southeastern Michigan: Michigan Univ. Mus. Paleontology Contr., v. 23, no. 3, p. 53-71, illus., 1969.

The Silica Shale, exposed in northwestern Ohio and southeastern Michigan, contains a relatively rich fauna of Phyllocarida (subclass Malacostraca). *Rhinocaris ehlersi*, was described by Stewart (1933) on the basis of one right valve of the carapace. Recent extensive collecting has revealed the other hard parts of this species, many specimens of *Echinocaris punctata* (Hall), specimens of *Dithyrocaris* sp. cf. *D. neptuni* Hall, and specimens of a new genus and species, *Hebertocaris wideneri*, from Silica, Ohio, which may be among the largest phyllocarids known. — *from* Authors' abstract

Stumm, Werner. *See* Hahn, Hermann H. 01665

01839 **Sturm, Edward.** A model for subaqueous slump structures [abs.]: EOS, v. 51, no. 4, p. 431, 1970.

Summerson, C. H. *See* Lindsay, John F. 01550

01869 **Suzuoki, Tetsuro; Epstein, Samuel.** Hydrogen isotope fractionation factors (a's) between muscovite, biotite, hornblende and water [abs.]: EOS, v. 51, no. 4, p. 451-452, 1970.

Swanson, Donald A. *See* Jackson, Dallas B. 01784

01840 **Swanson, Donald A.; Jackson, Dallas B.** 1968-70 Kilauea deformation — Summit [abs.]: EOS, v. 51, no. 4, p. 440-441, 1970.

01436 **Swanson, Roger W.** Mineral resources in Permian rocks of southwest Montana: U.S. Geol. Survey Prof. Paper 313-E, p. 661-777, illus., tables, 1970.

Permian strata underlie much of southwest Montana and contain large tonnages of commercial-grade phosphate in the Meade Peak and Retort Phosphatic Shale Mem-

bers of the Phosphoria Formation. The report area is generally south of Butte and west of Yellowstone National Park. Regional structure ranges from simple to very complex. The geologic setting of individual deposits is described. Other resources include uranium, for which tonnages are estimated; fluorine; several minor metals and rare earths; and oil shale. Many of these minerals and synthetic gypsum are potential byproducts. — RWS

Sweet, Walter C. *See* Bergström, Stig M. 09091

01488 **Swenson, Frank A.** Meandering of the Arkansas River since 1833 near Bent's Old Fort, Colorado, *in* Geological Survey research 1970, Chap. B: U.S. Geol. Survey Prof. Paper 700-B, p. B210-B213, illus., 1970.

Bent's Old Fort, constructed on the Santa Fe Trail in 1833 in southeastern Colorado, has been established as a National Historical Monument. The U.S. National Park Service is interested in determining the relative position of the fort, at the time it was occupied, to the meandering Arkansas River. Available data indicate there has been relatively little shift in the meanders of the river at this location. — Author's abstract

08854 **Swift, Donald J. P.** Evolution of the shelf surface, and the relevance of modern shelf studies to the rock record, Lecture 7 *in* The new concepts of continental margin sedimentation, application to the geological record — AGI short course lecture notes, Philadelphia, 1969: Washington, D. C., Am. Geol. Inst., p. DS7-1—DS7-19, illus., 1969.

The Cretaceous Peedee Formation on the Carolina coast is cited as an example of an ancient shelf deposit, and the distribution of the material within it is compared to the distribution of material on the modern shelf; from this is derived a general model for the textural evolution of a size-graded shelf. *In situ*, or autochthonous grading, and suspended load grading are the two major types. The comparative anatomy of modern and fossil shelves is discussed also, the Quaternary ones being considered anomalous. — HRC

08917 **Swift, Donald J. P.** Inner shelf sedimentation — Processes and products, Lecture 4 *in* The new concepts of continental margin sedimentation, application to the geological record — AGI short course lecture notes, Philadelphia, 1969: Washington, D. C., Am. Geol. Inst., p. DS4-1—DS4-46, illus., 1969.

Numerous factors are involved in inner shelf sedimentation, such as the material factors of rate of sediment input and character of the sediment, meteorologic, tidal, and density energy factors. Further, geometry plays a role in the nature of the orifices (deltas or estuaries), shape of the shore face, and the distribution of the sediments on the shore face. These, when acted upon by various hydraulic mechanisms, have resulted in a nearshore modern sand prism, beyond which are the relict shore deposits of the Pleistocene. Each of these factors is discussed, and the role it plays in the total model is described. — HRC

08918 **Swift, Donald J. P.** Outer shelf sedimentation — Processes and products, Lecture 5 *in* The new concepts of continental margin sedimentation, application to the geological record — AGI short course lecture notes, Philadelphia, 1969: Washington, D. C., Am. Geol. Inst., p. DS5-1—DS5-26, illus., 1969.

The outer shelf, beyond the influence of modern sediment input, is composed of material deposited during lower Pleistocene stands of the sea. This material is identifiable often by paleontological or glacial features, but often also by sedimentary distinctions. Energy sources which are acting on this material and altering it are waves, tidal currents, semipermanent currents (Gulf Stream, etc.). There is a vertical and horizontal textural unmixing of the Pleistocene material by the modern hydraulic factors, and the upper three or four feet is clearly a reworked shelf relict sand blanket. Relict and equilibrium topography show up in the ridge and swale systems of the outer shelf. Numerous examples are drawn from the Atlantic continental shelf of North America. — HRC

Sykes, Lynn R. *See* Savino, John. 01633

01470 **Szabo, B. J.; Dooley, J. R., Jr.; Taylor, R. B.; Rosholt, J. N.** Distribution of uranium in uranium-series dated fossil shells and bones shown by fission tracks, *in* Geological Survey research 1970, Chap. B: U.S. Geol. Survey Prof. Paper 700-B, p. B90-B92, illus., table, 1970.

Fission tracks show that uranium is dispersed throughout fossil shells and bones. However, a white layer of a shell may contain only half as much uranium as the darker organic-stained layer, and the surface layer of bone can be depleted in uranium. The distribution of uranium appears to be independent of age, uranium content, or departure from the ideal closed-system requirements. — Authors' abstract

Szekely, Julian. *See* Reitan, Paul H. 01820

01654 **Taggart, Ralph E.** A preliminary report on the pollen and spore flora of Miocene lignites and lignitic shales from the Sucker Creek area of eastern Oregon [abs.]: Geol. Soc. America Abs. with Programs, v. 2, no. 6, p. 407, 1970.

01597 **Taner, M. T.** Limitations of reflection-seismic method — Lessons from computer simulations [abs.]: Am. Assoc. Petroleum Geologists Bull., v. 54, no. 3, p. 557-558, 1970.

09005 **Tanguay, Marc G.; Hoffer, Roger M.; Miles, Robert D.** Multispectral imagery and automatic classification of spectral response for detailed engineering soils mapping, *in* Symposium on remote sensing of environment, 6th Internat., Ann Arbor, Mich., 1969, Proc., V. 1: Ann Arbor, Mich., Univ. Michigan, Willow Run Labs., p. 33-63, illus., table, 1969.

Multispectral imagery, obtained for a 70 mi route in central Indiana, involved evaluation of imagery taken in fifteen discrete bands of the spectrum as a source of data on engineering soils. The multispectral data was evaluated by (1) visual means, (2) densitometric measurements and (3) principally with the use of an automatic spectral response classification method developed at the Laboratory for Applications of Remote Sensing, Purdue University. Classification maps representing seven soil types of different engineering significance were obtained. There is an indication that useful automatic classification of soils can be made and printed on a computer map using multispectral data collected between the ultraviolet and far infrared range of the spectrum. Information on limited laboratory reflectance measurements is also reported. — *from* Authors' abstract

01568 **Tanguay, Marc Gilles.** Aerial photography and multispectral remote sensing for engineering soils mapping [abs.]: Dissert. Abs. Internat., Sec. B, Sci. and Eng., v. 30, no. 9, p. 4125B-4126B, 1970.

01841 **Taylor, Hugh P.** Oxygen isotope evidence for large-scale interaction between meteoric ground waters and Tertiary diorite intrusions, western Cascade Range, Oregon [abs.]: EOS, v. 51, no. 4, p. 453, 1970.

01842 **Taylor, Lawrence A.; Kullerud, Gunnar.** Mineral assemblages in the Cu-Fe-S-O system [abs.]: EOS, v. 51, no. 4, p. 452, 1970.

Taylor, Michael E. *See* Yochelson, E. L. 01501

Taylor, R. B. *See* Szabo, B. J. 01470

09064 **Tedrow, J. C. F.; Thompson, C. C.** Chemical composition of polar Soils: Biul. Peryglacjalny, no. 18, p. 169-181, illus., tables, discussion, 1969.

The polar regions are divided into three soil zones: (1) arctic brown soil zone, between tree line and high arctic, (2) polar desert soil zone, which is contiguous with the high arctic, (3) cold desert soil zone of Antarctica. Going from the arctic brown soil zone to the colder, drier, polar deserts of the high arctic and finally to the cold deserts of Antarctica, one encounters certain pedogenic changes. Scils of the northern fringes of the forest zone tend to have weak podzolic affinities. Progressing to cooler, drier conditions, soils could be described as a variety of cold steppe soils.

Soils of the high arctic and the antarctic continent have many features in common with those of temperate deserts. Representative deep, well-drained soils from each of the zones were analyzed for organic matter, pH values and chemical composition. — *from* Author's abstract

Tera, F. *See* Eugster, O. 01701

Termier, G. *See* Termier, H. 08956

08956 **Termier, H.; Termier, G.** Global palaeogeography and Earth expansion, *in* The application of modern physics to the earth and planetary interiors (S. K. Runcorn, editor): London and New York, Wiley-Interscience, p. 87-101, illus., 1969.

Paleogeographic arguments in favor of continental drift also favor the hypothesis of Earth expansion. Various paleogeographic clues to expansion evident in Precambrian, Paleozoic, Mesozoic, and Cenozoic times, and from comparing transgressions-regressions, epeirogenesis, bathygenesis, and glaciations are discussed. Four stages are postulated for the paleogeographic evolution of the crust: pre-geologic era without differentiated orogenic belts or consolidated shields and with very unstable crust; stage of separation of hydrosphere and atmosphere followed by development of erosional and sedimentary processes comparable to present; Riphean stage characterized by oxidizing atmosphere and epicontinental seas and high continentalization; and fossiliferous times beginning with Cambrian transgression in late Cambrian I. Continental drift and disruption occurred when primitive equilibration between oceanic and continental hemispheres ceased. — VSN

01646 **Texas A and M University.** (Activation Analysis Research Laboratory). 14-MeV neutron activation analysis of selected Leg 2 core samples [Chap.] 12 *in* Initial reports of the Deep Sea Drilling Project — V. 2, Leg 2 of cruises of *Glomar Challenger*, Hoboken, N. J., to Dakar, Senegal, Oct.-Nov. 1968: Washington, D. C., U.S. Govt. Printing Office, p. 347-348, table, 1970.

Analytical procedures are described, and the major-element composition of selected core samples tabulated. A weighted least-squares computer program was used to resolve the radioactivity from activation products of Si, Al, Fe, and Mg, and to compute the amount of each present. Uncertainty in the analytical results is expressed in absolute percent. — ESL

09116 **Thatcher, Wayne; Brune, James N.** Higher mode interference and observed anomalous apparent Love wave phase velocities: Jour. Geophys. Research, v. 74, no. 27, p. 6603-6611, illus., table, 1969.

For spherical earth models compatible with seismic observations, there is a significant frequency range over which fundamental and first higher Love mode group velocity curves approach each other closely or overlap. Higher mode interference is an important factor in interpretation and analysis of Love waves. Simple theoretical computations reveal the nature of the effect of mode contamination on measured phase velocities. It appears likely that fundamental mode Love waves experiencing higher mode interference will exhibit anomalously high apparent phase velocities, thus it may not be necessary to resort to complex or anisotropic models to explain these observations. Phase velocity filtering across a large array could effectively separate the modes. Love waves traversing continental regions will suffer little or no contamination from high modes for wave periods of less than about 60 sec and thus are preferred to oceanic paths in obtaining reliable fundamental mode data in this restricted frequency range. — *from* Authors' abstract

01649 **Thirlaway, H. I. S.** Earthquakes and explosions — Comment on Molnar et al [1969]: Nature, v. 225, no. 5239, p. 1237-1238, 1970.

It is not correct of Molnar and others (ibid. v. 224, no. 5226, p. 1268-1273, 1969; Abstracts of North American Geology, May 1970) to say that the shape of surface wave spectrums for discriminating between earthquakes and explosions had been hypothesized but not tested; spectral differences were demonstrated some two years

ago by the Blacknest group. Molnar's contribution demonstrates the value of broadening the recording band for this purpose, provided it can be done without raising the detection threshold, and that it is possible to eliminate environmental noise at the bottom of a deep mine and thereby operate at magnifications comparable to narrow band systems. The broader interests of seismologists are well served by this instrumental development, but in the more restricted field of underground explosions it remains to be seen whether a worldwide network of instruments in near-surface vaults can detect surface waves from small distant explosions. — DBV

Thompson, C. C. *See* Tedrow, J. C. F. 09064

Thompson, G. *See* Melson, W. G. 01859

Thomson, N. S. *See* Coker, A. E. 09093

01677 **Tidwell, William D.; Rushforth, Samuel R.; Reveal, James L.; Behunin, Homer.** *Palmoxylon simperi* and *Palmoxylon pristina*, two pre-Cretaceous angiosperms from Utah: Science, v. 168, no. 3933, p. 835-840, illus., 1970.

Petrified palm stems (*Palmoxylon simperi* and *Palmoxylon pristina*) from the Middle Jurassic Arapien Shale formation near Redmond, Sevier County, Utah, are the first unequivocal angiosperms reported from pre-Cretaceous strata. — Authors' abstract

01659 **Till, Roger.** The relationship between environment and sediment composition (geochemistry and petrology) in the Bimini lagoon, Bahamas: Jour. Sed. Petrology, v. 40, no. 1, p. 367-385, illus., table, 1970.

Surface sediments and overlying waters were analyzed and environmental data were collected; data were analyzed statistically for controls on geochemical variation. The physical environment (water quietness) is shown to govern organic and inorganic phase constituents, and these in turn govern bulk chemistry. Correlation analysis was repeated for the sample population from each of the three water masses in the lagoon (Turekian, 1957). The same basic control of water quietness is shown to be operative in each area. A simple analysis of variance for sample groups from each water mass showed that sediments from the three areas of different salinity in the lagoon are also significantly different in bulk constitution. But salinity of the waters is not simply related to sediment composition, for the three masses are also distinct in terms of physical environment, and it is this which is reflected in mean sediment composition. — *from* Author's abstract

01411 **Tilling, Robert I.; Gottfried, David; Dodge, F. C. W.** Radiogenic heat production of contrasting magma series — Bearing on interpretation of heat flow: Geol. Soc. America Bull., v. 81, no. 5, p. 1447-1462, illus., table, 1970.

Variation in radiogenic heat production of rocks of diverse magma series is better correlated with a magmatic differentiation index, such as the "lime-alkali" (Peacock) index, than with potassium content alone. Plots of heat production for igneous suites versus indices of differentiations ("heat production trends") demonstrate systematic correlations of heat productivity as functions of fractionation trends and/or spatial-temporal associations. In general, calcic suites tend to have lower radiogenic heat productivity than more alkalic suites for a given silica or potassium content. "Heat production trends" have an important bearing on the interpretation of crustal heat flow. — RAL

Tilton, G. R. *See* Church, Stanley E. 01747

Tocher, Don. *See* Romig, Philip R. 01624

01710 **Todorovic, P.** A stochastic model of longitudinal diffusion in porous media: Water Resources Research, v. 6, no. 1, p. 221-222, illus., tables, 1970.

A set of tagged particles carried along by a fluid flow through a porous medium is subject to random dispersion. The total distance from the origin, in the direction of

the main flow traveled by a tagged particle, is a stochastic process. To apply Lagrangian description of the dispersion, the distribution function of the traveled distance for every time t is determined. This distribution is not Gaussian and depends on two parameters which in turn depend on hydraulic conditions. To apply Eulerian description, the distribution function of time a tagged particle to travel a given distance x is derived. This distribution is not Gaussian either, and depends on the same two parameters. The sum of these two distributions is always one. This identity represents the relationship between Lagrangian and Eulerian descriptions. According to experimental results, the theoretical distributions agree reasonably well with observed distributions. — Author's abstract

Tokonami, Masayasu. *See* Morimoto, Nobuo. 01860

Tolderlund, D. S. *See* Ruddiman, W. F. 01643

09062 **Townsend, Frank C.; Manke, Phillip G.; Parcher, James V.** Effects of remolding on the properties of a lateritic soil: Highway Research Rec. 284 (Natl. Acad. Sci. Pub. 1661), p. 76-85, illus., tables, 1969.

Laboratory study of a Panamanian lateritic soil shows that remolding or working by mechanical agents alters physical properties and strength parameters. Grain-size analysis and Atterberg limits tests indicated breakdown of granular structure and increase in plasticity. The efficacy of various stabilizing additives was influenced considerably by amount of mechanical working; Portland cement, most effective of the three tested, yielded higher unconfined compressive strengths with unworked soil. Lime was also effective, but reacted more favorably with worked soil. The primary benefit from asphaltic stabilization was waterproofing. It is postulated that a substantial portion of the clay particles has been coated with iron and aluminum oxide films, which break down under working by mechanical agents, allowing more characteristic behavior of the clay particles. — GDC

01608 **Trescott, Peter C.; Pinder, George F.; Jones, John F.** Digital model of alluvial aquifer: Am. Soc. Civil Engineers Proc., v. 96, paper 7264, Jour. Hydraulics Div., no. HY 5, p. 1115-1128, illus., 1970.

Evaluation of an alluvial aquifer as a water supply for Antigonish, Nova Scotia, has demonstrated the versatility of the digital model as a tool in ground-water development and management. This model, which uses an alternating-direction implicit technique to solve the finite-difference approximation of the flow equation, is limited in size only by available hydrogeologic data, amount of computer storage, and availability of computer time. The model of the Antigonish aquifer, hydraulically connected to a river, was adjusted within constraints dictated by geology until model response to a pumping stress approached field response. Most critical factor was the river-bed hydraulic conductivity to thickness ratio which governs drawdown required to induce enough water from the river to sustain well production. The adjusted model was used to predict effect of establishing a multiple well field to meet the town's requirements. — *from* ASCE abstract

Truesdell, A. H. *See* White, Donald E. 01850

Trzcienski, W. E., Jr. *See* Carmichael, Dugald M. 01865

01506 **Tschudy, Robert H.; VanLoenen, Sharon D.** Illustrations of plant microfossils from the Yazoo Clay (Jackson Group, upper Eocene), Mississippi: U.S. Geol. Survey Prof. Paper 643-E, p. E1-E3, illus., 1970.

This publication illustrates a pollen and spore assemblage from the marine Yazoo Clay of Mississippi. The late Eocene age of the formation is well established by mollusks and Foraminifera. Figures on each plate are supplied with provisional generic identification. Many of the species have not previously been illustrated. — Authors' abstract

01843 **Tullis, Jan.** Dauphiné twinning produces preferred orientation in quartz aggregates [abs.]: EOS, v. 51, no. 4, p. 425, 1970.

01844 **Tullis, Terry E.** Preferred orientations of mica after high and low temperature deformation [abs.]: EOS, v. 51, no. 4, p. 425, 1970.

01700 **Turekian, K. K.; Kharkar, D. P.; Funkhouser, J.; Schaeffer, O. A.** An evaluation of the uranium-helium method of dating of fossil bones: Earth and Planetary Sci. Letters, v. 7, no. 5, p. 420-424, table, 1970.

From our study of six bones of Oligocene age from different sites of one locality (the Fayum beds of Egypt) and three bones of Pleistocene or Pliocene age we conclude that the general applicability of uranium-helium method of dating is not possible for fossil bones or other apatite deposits. The major problem appears to be continuous helium loss rather than recent uranium gain. — Authors' abstract

01580 **Tuthill, Samuel James.** A comparison of the Late Wisconsinan molluscan fauna of the Missouri Coteau district (North Dakota) with a modern Alaskan analogue [abs.]: Dissert. Abs. Internat., Sec. B, Sci. and Eng., v. 30, no. 9, p. 4211B, 1970.

Uchupi, Elazar. *See* Oldale, R. N. 01481

01479 **Upson, Joseph E.** The Gardiners Clay of eastern Long Island, New York — A reexamination, *in* Geological Survey research 1970, Chap. B: U.S. Geol. Survey Prof. Paper 700-B, p. B157-B160, illus., table, 1970.

Certain nonfossiliferous bodies of clay and fine sand exposed in the Mattituck quadrangle, north shore of Long Island, N. Y., identified by Fuller as Gardiners Clay and Jacob Sand, are interbedded with the Herod Gravel Member of the Manhasset Formation, advance outwash of ice that deposited the Montauk Till Member of the Manhasset Formation. The clay beds may be equivalent to the type Gardiners Clay, but are higher in the stratigraphic sequence than Fuller placed the unit. They are evidently also stratigraphically higher than fossiliferous clays penetrated in wells in central and western Long Island and called Gardiners. The writer believes that the term Gardiners Clay either needs to be redefined, or restricted in usage. — Author's abstract

01515 **U.S. Geological Survey.** Geological Survey research 1970, Chap. B: U.S. Geol. Survey Prof. Paper 700-B, p. B1-B267, illus., tables, 1970.

Forty-six summaries and scientific notes on research represent the following fields: petrology and petrography, structural geology, geophysics, geochronology, economic geology, paleontology, stratigraphy, sedimentation, geomorphology, analytical methods, ground-water recharge, ground-water contamination, surface water, relation between ground water and surface water, erosion and sedimentation, geochemistry of water, and hydrologic techniques. Forty-one papers are cited separately. — MCM

01653 **U.S. Geological Survey.** Apollo 6 photomap — West-east corridor from the Pacific Ocean to northern Louisiana: Washington, D. C., U.S. Geol. Survey, 4 sheets, 1970.

01845 **Usdowski, E.; Knoke, R.** Paleo-humidity indicators in marine evaporites [abs.]: EOS, v. 51, no. 4, p. 452, 1970.

01465 **VanAlstine, Ralph E.** Allochthonous Paleozoic blocks in the Tertiary San Luis-Upper Arkansas graben, Colorado, *in* Geological Survey research 1970, Chap. B: U.S. Geol. Survey Prof. Paper 700-B, p. B43-B51, illus., 1970.

Allochthonous breccia blocks of Paleozoic rocks, localized within or near a late Tertiary trough between the Sawatch and Sangre de Cristo Ranges of south-central Colorado, evidently were the result of gravitational sliding several miles eastward from the Sawatch Range. Seventeen detached Paleozoic blocks within the Dry Union Formation of Miocene and Pliocene age are exposed in areas of as much as 400 by 800 feet and for heights of about 150 feet. To the west, six remnants of Paleozoic carbonate rocks, some in areas underlain by unconsolidated fill, also may be detached blocks. Similar detached blocks have been reported along the margins of other basins in the western United States. — Author's abstract

08959 **VanAndel, S. I.; Hospers, J.** New determinations of ancient Earth radii from palaeomagnetic data, *in* The application of modern physics to the earth and planetary interiors (S. K. Runcorn, editor): London and New York, Wiley-Interscience, p. 113-121, illus., tables, 1969.

The triangulation method of calculating ancient Earth radii from paleomagnetic data is illustrated by a spherical triangle depicting calculation of the anguiar magnitude of an arc, by means of which separation of the paleomagnetic poles D and E is measured as a function of a variable ancient Earth's radius. Calculated ratios of Devonian through Cretaceous radii to the present radius are given and compared with results from Egyed's paleomeridian and Ward's minimum dispersion methods. From position of the points representing the calculated ratios and of eight straight lines fitted to these points, it is clear that the Egyed expansion rate, a constant radius of the Earth, or a slow contraction are more plausible than the fast expansion rates advocated by Hilgenberg, Carey, van Hilten, and Heezen. — VSN

01667 **VanDiver, Bradford B.** Origin of biotite orbicules in "Bullseye Granite" of Craftsbury, Vermont: Am. Jour. Sci., v. 268, no. 4, p. 322-340, illus., tables, 1970.

This stock intrudes the Waits River Formation of calcareous phyllitic and quartzitic metasediments. The orbicules consist of about 50 percent biotite with strong concentric orientation, in a coarser-grained matrix of quartz, muscovite, plagioclase, and other minerals. The orbicules result from the early crystallization of the biotite from a nonviscous melt, followed by the formation of orbicules by coherence of numerous, increasingly spherical layers of biotite flakes around nuclei. The nuclei consisted either of aggregated-flocculated biotite flakes or of gas bubbles migrating upward through the magma. Subsequent cooling caused crystallization of residual magma in the orbicules and elsewhere. Biotite growth continued nearly to complete consolidation of magma, annealing nearly all crystal distortion caused by microfolding. — *from* Author's abstract

VanLoenen, Sharon D. *See* Tschudy, Robert H. 01506

01531 **VanVoast, W. A.; Jerabek, L. A.; Novitzki, R. P.** Water resources of the Redwood River watershed, southwestern Minnesota: U.S. Geol. Survey Hydrol. Inv. Atlas HA-345, 3 sheets, various scales, text, 1970.

Sheet 1 contains block diagrams, inset maps and graphs on the water budget, recreation maps, and a summary of total water use, municipal supplies, and a table on suitability of water. Sheet 2 contains maps, tables, text, and diagrams on ground water. Precambrian rocks yield water from weathered or fractured zones at their surface; sandstone beds in Cretaceous rocks yield substantial supplies in the central part; sand and gravel deposits at different depths in glacial drift are most accessible and widely used aquifers. Water quality varies with position in the flow system; water is usually very hard and contains high concentrations of dissolved solids. An analysis of 600 drift wells shows a median yield of 6 gpm and a median specific capacity of 1.2 gpm per foot of drawdown. Sheet 3 contains information on surface water. — MCM

VanWormer, J. D. *See* Romig, Philip R. 01624

09119 **Varela Hernández, A.** Problemas de la exploración petrolera en el homoclinal de San José de las Rusias, Tam. [abs.]: Inst. Mexicano Petróleo Rev., v. 1, no. 3, p. 81-82, 1969.

09047 **Vary, Willard E.** Remote sensing by aerial color photography for water depth penetration and ocean bottom detail, *in* Symposium on remote sensing of environment, 6th Internat., Ann Arbor, Mich., 1969, Proc., V. 2: Ann Arbor, Mich., Univ. Michigan, Willow Run Labs., p. 1045-1059, illus., tables, 1969.

Aerial color photography is an airborne remote sensor that shows promise for worldwide hydrographic surveys. The first test was made in 1967 in the Florida Keys area using regular color emulsions with various film-filter combinations at several altitudes. The test range included land, sea, and a coral reef; color targets were placed on land and underwater near the reef. Results indicated that the green portion of the

spectrum yielded best results; a new aerial color emulsion, originated to eliminate blue light interference, is nonblue sensitive and thus blind to blue light interference. A second test in the area of Andros Island, Bahamas, employed the new emulsion for the first time. Ocean bottom detail was verified by divers to depths of 150 feet; interference filters showed that the 560 millimicron portion of the spectrum obtained the best penetration and bottom detail. — *from* Author's abstract

Venkitasubramanyan, C. S. *See* Wenk, H. R. 01870

09080 **Vineyard, Jerry D.** Distribution and characteristics of caves in Missouri [abs.]: Natl. Speleol. Soc. Bull., v. 31, no. 2, p. 46-47, 1969.

01496 **VonHerzen, R. P.; Simmons, G.; Follnsbee, A.** Heat flow between the Caribbean Sea and the Mid-Atlantic Ridge: Jour. Geophys. Research, v. 75, no. 11, p. 1973-1984, illus., tables, 1970.

Despite a large variability, a systematic pattern of heat flow is discernible from 41 new measurements between the Caribbean Sea and the Mid-Atlantic Ridge. The highest values are measured within 200 km of the Mid-Atlantic Ridge crest, and low heat flow occurs 300 to 600 km west of the ridge crest. A smaller-scale pattern is found from more detailed measurements between fracture zones between 9° and 12°N latitude. The equilibrium heat flux beneath the thickly sedimented floor of the Vema fracture is probably about twice the measured values of 3.0 HFU (μcal/cm^2 sec). — Authors' abstract

08877 **Vozoff, K.; Halpin, D.; Lahman, H. S.; Orange, A. S.** Use of natural EM fields in exploration of sedimentary areas [abs.]: Geophysics, v. 34, no. 6, p. 1007-1008, 1969.

08925 **Waddell, G. G.** Progress on techniques of investigating and of controlling rock bursts [abs.]: Mining Eng., v. 21, no. 12, p. 58, 1969.

01846 **Wagner, G. A.; Reimer, M.; Storzer, D.** Critical consideration of experimental values used in fission track dating [abs.]: EOS, v. 51, no. 4, p. 450, 1970.

01863 **Wai, Chien M.; Wasson, John T.** Silicon in the Nedagolla ataxite and the relationship between Si and Cr in reduced iron meteorites: Geochim. et Cosmochim. Acta, v. 34, no. 3, p. 408-410, table, 1970.

The Nedagolla ataxite contains 0.14 percent Si in the metal. The high Cr contents of this meteorite and the previously studied high-Si iron, Tucson, suggest an association between Cr and Si. A study of irons with contents of Ni, Ga, Ge and Ir similar to those in Nedagolla and Tucson resulted in the discovery of 2 ataxites with slightly elevated Cr contents, but Si concentrations less than 30 ppm. — Author's abstract

Walker, John L. *See* Bradshaw, Peter M. D. 01728

Walker, R. M. *See* Fleischer, R. L. 08973

01588 **Walker, Robert D.** Geologic data processing — An effective exploration tool [abs.]: Am. Assoc. Petroleum Geologists Bull., v. 54, no. 3, p. 554, 1970.

09113 **Walker, Walter W.** A study of fulgarites[!] collected from two locations on Mount Lemmon [abs.]: Arizona Acad. Sci. Jour., v. 5, 1969 Proc. Supp., p. 34, 1969.

Walsh, H. R. J. *See* Dove, R. P. 09059

08886 **Ward, S. H.; Jepsen, A. F.** Geophysical results from Coppermine, Northwest Territories [abs.]: Geophysics, v. 34, no. 6, p. 1019-1020, 1969.

Warren, C. G. *See* Jacobs, M. L. 01483

01847 **Warren, Richard C.** Electron microprobe investigations of almandine garnets from a quartz diorite stock and adjacent metamorphic rocks, British Columbia [abs.]: EOS, v. 51, no. 4, p. 444, 1970.

09065 **Washburn, A. L.** Patterned ground in the Mesters Vig district, northeast Greenland: Biul. Peryglacjalny, no. 18, p. 259-330, illus., tables, 1969.

The present article is a slightly abbreviated version of a report entitled "Weathering, frost action, and patterned ground," which appeared as Meddelelser om Grönland, v. 176, no. 4, 313 p., 1969. (Abstracts of North American Geology, August, 1970.) —EH

Wasserburg, G. J. *See* Eugster, O. 01701

Wasserburg, G. J. *See* O'Connell, Richard J. 01808

Wasson, John T. *See* Wai, Chien M. 01863

Watkins, Norman D. *See* Gunn, Bernard M. 01412

01848 **Wawersik, Wolfgang R.; Brace, William F.** Post-failure study of granite and diabase [abs.]: EOS, v. 51, no. 4, p. 423, 1970.

Webb, Wayne E. *See* Weigle, James M. 01607

01509 **Weber, Florence R.; Péwé, Troy L.** Surficial and engineering geology of the central part of the Yukon-Koyukuk lowland, Alaska: U.S. Geol. Survey Misc. Geol. Inv. Map I-590, 2 sheets, scale 1:125,000, table, 1970.

Sheet 2 contains diagrammatic profiles of localities along the Koyukuk and Yukon Rivers, mechanical analyses of representative samples collected in the Yukon-Koyukuk lowland, and a table of the Jurassic-Quaternary geologic units that indicates their lithology, distribution and thickness, drainage, vegetation, permafrost, susceptibility to frost action, bearing strength and slope stability, excavation and compaction, and evaluation for road construction and other uses. — MCM

Weber, H. P. *See* Hafner, S. S. 01772

01451 **Weber, J. R.; Andrieux, Pierre.** Radar soundings on the Penny Ice Cap, Baffin Island [with French and German abs.]: Jour. Glaciology, v. 9, no. 55, p. 49-54, illus., 1970.

Radar echo soundings were carried out by the Dominion Observatory Ottawa in 1965 on an outlet glacier of the Penny Icecap in Baffin Island. An unmodified 440 MHz SCR-718 radar altimeter was used, of a type readily and inexpensively available on the surplus market. Radar soundings were generally in agreement, within range of reading accuracy of the oscilloscope (±15 m), with depths obtained seismically, gravimetrically, and by electrical resistivity. Minimum and maximum recorded depths were 45 m and 550 m, respectively. Visual recording of pip positions on the standard oscilloscope was not satisfactory, but the instrument could easily be modified to incorporate a larger oscilloscope with continuous photographic recording.—*from* Authors' abstract

01490 **Weeks, John B.** The relationship between surface water and ground water in Ship Creek near Anchorage, Alaska, *in* Geological Survey research 1970, Chap. B: U.S. Geol. Survey Prof. Paper 700-B, p. B224-B226, illus., table, 1970.

Ship Creek drainage basin is an important recharge area for the Anchorage artesian aquifer. Discharge records show Ship Creek loses an average of 25 cfs in the recharging area and gains about 22 cfs in the reach below the recharge area. A water-budget analysis demonstrates that of this gain at least 11 cfs is ground-water return flow from the recharge area. — Author's abstract

01425 **Weems, John H.** In memoriam — George Irwin McFerron (1895-1969): Houston Geol. Soc. Bull., v. 12, no. 6, p. 20-21, 1970.

Weiblen, P. W. *See* Grant, James A. 01766

01418 **Weidie, A. E.; Martinez, Joseph D.** Evidence for evaporite diapirism in northeastern Mexico: Am. Assoc. Petroleum Geologists Bull., v. 54, no. 4, p. 655-657, illus., 1970.

Intrusive gypsum is known in this region, and salt diapirism has been inferred. Core studies indicate that the complete sequence of evaporites behaved as a mobile unit during tight folding. Salt diapirism is indicated in Sierra del Fraile and Sierra Minas Viejas by steeply dipping planar fabric and abnormal thickness. — EGS

Weigand, Peter W. *See* Dunn, David E. 08996

01607 **Weigle, James M.; Webb, Wayne E.; Gardner, Richard A.** Water resources of southern Maryland: U.S. Geol. Survey Hydrol. Inv. Atlas HA-365, 3 sheets, scales about 1 in. to 4 mi. and 1 in. to 8 mi., text, 1970.

Sheet 1 covers hydrology, sheet 2 ground-water yields, and sheet 3 quality of water and streamflow. Although ground water occurs in all geologic formations in southern Maryland, it can be withdrawn in significant quantities only where materials are permeable enough to permit ground water to move fairly freely; units and their geohydrologic characteristics are tabulated and described. Maps show short-term ground-water yields available from the Aquia and Piney Point-Nanjemoy hydrologic units (< 100 to 900 gpm). Water is suitable for domestic and many industrial uses without treatment, although quality changes from one area to another. The position of the salt water-fresh water interface in the confined aquifers is not known precisely. — MCM

Weill, D. F. *See* Bottinga, Y. 01740

Weinberg, Bernhard. *See* Ehrlich, Robert. 01537

Weist, W. G., Jr. *See* Davidson, E. S. 01645

01452 **Wellman, Thomas Robert.** The stability of sodalite in a synthetic syenite plus aqueous chloride fluid system: Jour. Petrology, v. 11, no. 1, p. 49-71, illus., tables, 1970.

Experimental investigations showed sodalite to be a stable phase in the vapor-saturated liquidus in the system $NaAlSi_3O_8$-$KAlSi_3O_8$-$KAlSiO_4$-NaCl-KCl-H_2O over a wide range of pressure. The sodalite stability curve derived by plotting the initial $H_2O/(H_2O$ + chloride) ratio in the melt versus fluid pressure along the minimum melting curve permits definition of three distinct types of sodalite-bearing syenite. In a closed system the effects of cooling differ from those produced in an open system involving diffusive and infiltrative metasomatic mechanisms. — MS

01870 **Wenk, H. R.; Baker, D. W.; Brimhall, G.; Venkitasubramanyan, C. S.** Preferred orientation in experimentally deformed Solenhofen Limestone [abs.]: EOS, v. 51, no. 4, p. 425, 1970.

01591 **Weser, Oscar E.** Stratigraphy and sedimentation of JOIDES holes off California coast [abs.]: Am. Assoc. Petroleum Geologists Bull., v. 54, no. 3, p. 555, 1970.

Wesolowski, E. A. *See* Croft, Mack G. 01484

08982 **Weyl, Richard.** Geologische Bilder aus Mittelamerika — [Pt.] 1, Kreidezeitlicher Ozeanboden in Costa Rica; [Pt.] 2, Die pazifische Felsküste Costa Ricas: Natur u. Mus., v. 99, no. 9, p. 415-423, illus., table; ibid., no. 12, p. 559-570, illus., 1969.

Reviewing the geology of Costa Rica, the first part of this article deals with the Cretaceous ocean floor and continental crust of the region, comparing composition and thickness of the silica-rich and basaltic rocks, the named Nicoya-Complexes, marine sedimentation, and coastal erosion, with sketch maps of Caribbean paleogeography in Upper Cretaceous and Paleozoic times. The second part discusses the rugged Pacific coast, reflecting deep-seated structural change, its mountain chains and peninsulas alternating with bays and intermittent beaches, in contrast to

the broad shelf of northern Central America. A ridge of many submerged conical mountains, presumably dead volcanoes, rises above sea level in Cocos Island. Ebb tides expose sedimentary rocks dipping steeply seaward; eroded beach rock terraces are solution pitted. — GDC

01850 **White, Donald E.; Truesdell, A. H.; Muffler, L. J. P.** Vapor-dominated hydrothermal systems [abs.]: EOS, v. 51, no. 4, p. 453, 1970.

White, G. *See* Kuo, J. T. 01674

White, Joe L. *See* Low, Philip F. 01725

01534 **White, Stan M.** Mineralogy and geochemistry of continental shelf sediments off the Washington-Oregon coast: Jour. Sed. Petrology, v. 40, no. 1, p. 38-54, illus., tables, 1970.

Three depositional areas are present on the shelf: a nearshore area including the lower portion of the Columbia River estuary and a main shelf area, both characterized by poorly sorted sediments, and a third area seaward of 80 fm which is characterized by glauconitic sediments. Within each area the mineral and chemical compositions of the sediments appear distinctive and characteristic for the area. The glauconite in the continental shelf sediments is generally found in the deeper shelf areas. It is derived from glauconitic-bearing Tertiary sedimentary rocks exposed in the area, some may be transported north from the shelf areas off central and southern Oregon and some may be forming in place. Boron is associated with the glauconite and may be indicative of the presence of glauconite or as an indicator of the marine environment. — *from* Author's abstract

White, William B. *See* Rutstein, Martin S. 01825

01851 **White, William B.** Vibrational spectra of olivine [abs.]: EOS, v. 51, no. 4, p. 436, 1970.

09069 **White, William B.** Conceptual models for carbonate aquifers [abs.]: Natl. Speleol. Soc. Bull., v. 31, no. 2, p. 38-39, 1969.

08907 **Whitebread, Donald H.** Geologic map of the Wheeler Peak and Garrison quadrangles, Nevada and Utah: U.S. Geol. Survey Misc. Geol. Inv. Map I-578, scale 1:48,000, sections, separate text, 1969.

01852 **Whitney, James A.; Luth, W. C.** Water undersaturated melting of natural granites at 2 kb [abs.]: EOS, v. 51, no. 4, p. 438, 1970.

01853 **Whitney, Philip R.** Significance of coronitic reactions in Adirondack metagabbros [abs.]: EOS, v. 51, no. 4, p. 446, 1970.

01849 **Wickham, J. S.; Elliott, D. E.** Rotation and strain history in folded carbonates, Front Royal area, Virginia [abs.]: EOS, v. 51, no. 4, p. 422, 1970.

Wideman, C. J. *See* Romig, Philip R. 01624

Wildung, R. E. *See* Routson, R. C. 09035

Wilkniss, P. E. *See* Brewer, P. G. 01640

01854 **Williams, David L.; Roy, Robert F.** Measurement of heat flow in lakes by a combination of oceanic and continental techniques [abs.]: EOS, v. 51, no. 4, p. 425-426, 1970.

01505 **Williams, Harold; Kennedy, M. J.; Neale, E. R. W.** The Hermitage Flexure, the Cabot Fault, and the disappearance of the Newfoundland Central Mobile Belt: Geol. Soc. America Bull., v. 81, no. 5, p. 1563-1567, illus., 1970.

The Central Mobile Belt of the Appalachian System in Newfoundland varies in width from 130 mi on the northern coast to about 40 mi on the southern coast. Assuming constant width for the Belt during the developmental stages, its southward thinning can be explained first by open folding around the Hermitage Flexure, and then by westward truncation by left-lateral displacement along the Cabot Fault. — *from* Authors' abstract

01685 **Williams, P. M.; Gordon, L. I.** Carbon-13/carbon-12 ratios in dissolved and particulate organic matter in the sea: Deep-Sea Research, v. 17, no. 1, p. 19-27, illus., tables, 1970.

A technique has been developed for the determination of the C-13/C-12 ratios in the dissolved organic matter in the sea. Results of 18 samples from the northeast Pacific show that these ratios and those for five samples of particulate organic carbon are between -21.2 and -24.4. The ratios are essentially invariant with depth and time, and do not correlate with dissolved oxygen or total dissolved organic carbon. These results suggest a singular and common source for the dissolved and particulate organic matter and that this material is stable to biochemical fractionation. — Authors' abstract

Williamson, T. G. *See* Dove, R. P. 09059

Willson, J. E. *See* Bohidar, N. K. 08924

Willson, J. E. *See* Seegmiller, B. L. 08928

01480 **Winegard, Charles I.** Settling velocity of grains of quartz and other minerals in sea water versus pure water, *in* Geological Survey research 1970, Chap. B: U.S. Geol. Survey Prof. Paper 700-B, p. B161-B166, illus., tables, 1970.

The settling velocities of particles in sea water differ significantly from those in fresh water. For example, a 10-micron-diameter quartz sphere in sea water will settle 4,000 meters in 882 days. The same particle in fresh water will settle to that depth in 824 days, 6.58 percent less time. Velocities in sea water can be calculated for a spherical particle of given size and composition if the viscosity and specific gravity of the water are known. — Author's abstract

09013 **Wise, Donald U.** Pseudo-radar topographic shadowing for detection of sub-continental sized fracture systems, *in* Symposium on remote sensing of environment, 6th Internat., Ann Arbor, Mich., 1969, Proc., V. 1: Ann Arbor, Mich., Univ. Michigan, Willow Run Labs., p. 603-615, illus., 1969.

Radar imagery of real topography or photos of side-illuminated raised plastic relief maps enhance many elements of linear topography, particularly those valleys with strikes at acute angles to light sources so that illumination grazes one of the walls. Many linears appearing on relief maps with scales from 1:62,500-1:1,000,000, are commonly arranged in 6 to 8 strike sets with individual linears persisting for 100 miles or more, the sets themselves continuing for many hundreds of miles. The shadow enhancement technique applied to plastic relief maps permits rapid mapping of linears over vast areas. The requirement of the same linear appearing under a variety of lighting provides some control on operator-generated pseudolinears. The method may be cheaper and easier than traditional photolinear or radar-linear analysis. Problems with illumination azimuth and selective enhancement of certain linears suggest the need for caution in radar linear analysis and in lunar photolinear analysis. — *from* Author's abstract

Witham, K. *See* Niblett, E. R. 08960

01466 **Witkind, I. J.; Kleinkopf, M. D.; Keefer, W. R.** Geologic and gravity evidence for a buried pluton, Little Belt Mountains, central Montana, *in* Geological Survey research 1970, Chap. B: U.S. Geol. Survey Prof. Paper 700-B, p. B63-B65, illus., 1970.

Gravity contours delineate a buried pluton that has domed Precambrian metamorphic crystalline rocks exposed in the core of the Little Belt Mountains, central Montana. The pluton, probably of Tertiary age, appears to be a northeastward-trending ovoid body 3 miles wide and possibly as much as 7 miles long. — Authors' abstract

08878 **Wold, Richard J.; Woodzick, Thomas; Ostenso, Ned A.** Gravity study in the Beaufort Sea [abs.]: Geophysics, v. 34, no. 6, p. 1008, 1969.

Wolf, Ronald J. *See* Daniel, James F. 01489

01712 **Wolff, Roger G.** Field and laboratory determination of the hydraulic diffusivity of a confining bed: Water Resources Research, v. 6, no. 1, p. 194-203, illus., table, 1970.

For evaluations of hydraulic diffusivity presented here, the field approach consisted of measuring the head in the confining layer by placing piezometers equipped with differential pressure transducers at different depths in this layer. Pumping from the overlying aquifer resulted in an observed head change at the aquifer confining bed interface which for long periods of time could be approximated by a step drawdown. The best fit of observed data to the set of theoretical type curves for the step drawdown solution yields a hydraulic diffusivity of 2.9×10^{-2} cm^2/sec. Hydraulic diffusivity values for natural effective load obtained in the laboratory are in general agreement with this result. Hydraulic conductivity values determined in the laboratory are generally similar for the same sample. Particle size distribution and clay mineralogy are given for each sample. — *from* Author's abstract

01641 **Wong, C. S.** Quantitative analysis of total carbon dioxide in sea water — A new extraction method: Deep-Sea Research, v. 17, no. 1, p. 9-17, illus., tables, 1970.

The concentration of total carbon dioxide in sea water has been determined to a precision of ± 0.15 percent standard deviation and an accuracy of about ± 0.2 percent by a new method which employs a vacuum extraction and infrared analysis. A comparison of extractions made on shipboard and those made later in the shore laboratory on preserved samples shows that ocean water sterilized with 100 ppm of mercuric chloride does not change its total carbon dioxide on storage in stoppered Pyrex bottles at room temperature for a period up to 3 months. — Author's abstract

Wood, P. *See* Gurk, H. M. 09094

01533 **Wood, William H.** Rectification of wind-blown sand: Jour. Sed. Petrology, v. 40, no. 1, p. 29-37, illus., table, 1970.

The two processes by which the composition of debris becomes stabilized after traveling 10 to 12 miles by eolian saltation and creep are called rectificatio ı. Rectification of wind-blown sand occurs by repeated interaction of a saltation and creep fraction that are almost in equilibrium. Mathematical models are developed to analyze the process. Sands may be classified as unimodal, bimodal, or polymodal by their stability-frequency curves. The models predict that in some cases an initially unimodal sand may become bimodal, and later unimodal again as rectification becomes more nearly complete and distance from the source of sand supply increases. In some cases in a sand mixture the percent of grains of a given saltability class may reach a maximum and then decrease as rectification proceeds. — *from* Author's abstract

01415 **Woodward, Lee A.** Tectonic implications of structure of Beaver and northern San Francisco Mountains, Utah: Geol. Soc. America Bull., v. 81, no. 5, p. 1577-1583, illus., 1970.

The concept of eastward thrusting of miogeosynclinal rocks along laterally continuous zones in western Utah has been challenged by Eardley (1968, 1969), who postulates local uplifts and gravity slide masses moving in various directions. Eardley's use of the San Francisco Mountain as an example of a southwest moving plate originating in the Beaver Mountains is challenged. Evidence derived from detailed mapping in

the Beaver and San Francisco Mountains indicates no glide surface as hypothesized by Eardley but instead eastward yielding along a laterally continuous thrust. — *from Author's abstract*

Woodzick, Thomas. *See* Wold, Richard J. 08878

01686 **Wornardt, W. W., Jr.** Fossil diatoms and silicoflagellates from Newport Beach, California, studied with scanning electron microscope [abs.]: Am. Assoc. Petroleum Geologists Bull., v. 54, no. 3, p. 558, 1970.

Worzel, J. Lamar. *See* Ewing, Maurice. 09110

01668 **Wynne-Edwards, H. R.; Hasan, Zia-Ul.** Intersecting orogenic belts across the North Atlantic: Am. Jour. Sci., v. 268, no. 4, p. 289-308, illus., tables, 1970.

If the Canadian structural provinces (except for the Grenville which transects them all) are linked across the North Atlantic to their equivalent radiometric units in Europe, the transgression of the Grenville type becomes much more evident. The eastward extension of the Grenville front truncates a further two or three boundaries of older provinces, and the Taconic and Acadian belts, parallel in North America, diverge at right angles to the Caledonian and Hercynian belts in Europe. The entire Grenville and Churchill provinces are traversed by the Caledonian belt, but their extensions reappear on the eastern side of Scandinavia. To illustrate these features, the continents on either side of the North Atlantic have been diagrammatically restored to a precontinental-drift position and the various structural-radiometric provinces that then appear are defined and named. — *from* Authors' abstract

01855 **Yanase, Y.; York, Derek.** Elucidation of Grenville thermal histories with Ar-40/Ar-39 measurements [abs.]: EOS, v. 51, no. 4, p. 434, 1970.

Yeh, Ko-Shing. *See* Nielson, F. Dwayne. 09056

01516 **Yeh, William Wen-Gong.** Nonsteady flow to surface reservoir: Am. Soc. Civil Engineers Proc., v. 96, paper 7137, Jour. Hydraulics Div., no. HY 3, p. 609-618, illus., table, 1970.

When ground water flows from an unconfined aquifer to a surface reservoir the position of the water table will change with time. The nonlinear partial differential equation for water table elevation is transformed to a nonlinear ordinary differential equation by similarity substitution. A numerical procedure for its solution and a method of computing bank storage are presented. The solution compares favorably with the experimental results obtained by others. — ASCE abstract

01704 **Yen, Chin-lien.** Bed topography effect on flow in a meander: Am. Soc. Civil Engineers Proc., v. 96, paper 7003, Jour. Hydraulics Div., no. HY 1, p. 57-73, illus., table, 1970.

Stabilized bed topography in a meandering channel with fixed walls and movable bed was measured at various width-depth ratios and Froude numbers. Velocity and bed-shear distributions were measured in a fixed-bed model whose configuration conformed to the stabilized topography of the movable-bed model. An approximate theoretical analysis of the bed configuration under fully developed flow conditions shows that the transverse bed slope is directly proportional to a parameter characterizing the relative importance of fluid inertia compared with the gravity acting on a particle. Good agreement has been observed between the theoretical and experimental results in the downstream half of the model channel. The effects of formation of the bed topography on the flow characteristics are considered. — ASCE abstract

01501 **Yochelson, E. L.; Pierce, J. W.; Taylor, Michael E.** *Salterella* from the Lower Cambrian of central Nevada: U.S. Geol. Survey Prof. Paper 643-H, p. H1-H7, illus., tables, 1970.

Specimens of the Early Cambrian fossil *Salterella* have been obtained from the Toquima Range in Nevada. The fossils are small simple cones of calcium carbonate on the exterior; the interior is filled with clastic grains arranged in laminae essentially at right angles to the aperture. The interior grains are smaller and have a much higher concentration of heavy minerals relative to the matrix, suggesting purposeful selection of the grains. — ELY

08922 **Yochelson, Ellis L.** Gastropods and pelecypods, Chap. 9 *in* History of the Redwall Limestone of northern Arizona: Geol. Soc. America Mem. 114, p. 439-451, illus., tables, 1969.

Almost all of the gastropods came from one area in the Redwall Limestone. The collection is small and scattered and most are euomphalids. While most are from the Mooney Falls and Horseshoe Mesa Members, they are of little use in determining stratigraphic divisions. The gastropods are illustrated but not described. Pelecypods are about one-fifth as abundant as gastropods and fall within 7 genera and 10 species; a few representative types are illustrated. — HRC

York, Derek. *See* Berger, Glen W. 01737

York, Derek. *See* Yanase, Y. 01855

Young, Robert A. *See* Bredehoeft, John D. 01718

01569 **Yudhbir.** Engineering behaviour of heavily overconsolidated clays and clay shales with special reference to long-term stability [abs.]: Dissert. Abs. Internat., Sec. B, Sci. and Eng., v. 30, no. 9, p. 4126B, 1970.

09051 **Zakrzewski, Richard J.** The rodents from the Hagerman local fauna, Upper Pliocene of Idaho: Michigan Univ. Mus. Paleontology Contr., v. 23, no. 1, p. 1-36, illus., tables, 1969.

The Hagerman local fauna is known from fluvial deposits of the Glenns Ferry Formation in Twin Falls County, Idaho; about 300 localities are exposed over 6 sq mi, through 500 feet of beds (2900-3400 feet a.s.l.). There are at least 14 genera and 19 species of rodents: five sciurid species, two castorid (one new), two geomyid (one new), three heteromyid (two new), seven cricetid (one new). The beaver *Castor* and microtine cricetids *Cosomys* and *Pliopotamys* are the most abundant mammals, suggesting a marsh-meadow habitat. Upland rodents are rare. Population structure of microtines changes going up the section; *Cosomys* is gradually replaced by *Pliopotamys* and *Ophiomys*. Radiometric dates on correlated volcanics indicate a Late Pliocene age for the fauna; stage of evolution of the rodents suggests a post-Rexroad age. — VMJ

Zeitlin, Harry. *See* Kentner, Edward. 01512

09127 **Zen, E-an.** Free energy of formation of pyrophyllite from hydrothermal data — Values, discrepancies, and implications: Am. Mineralogist, v. 54, nos. 11-12, p. 1592-1606, illus., table, 1969.

The standard free energy of formation of pyrophyllite is calculated from reversed hydrothermal data. The value falls into two distinct groups: about -1251 kcal from breakdown of kaolinite + quartz, and about -1258 kcal from pyrophyllite breakdown into andalusite + quartz, or pyrophyllite + corundum into kyanite. The second value agrees with a direct determination by solubility measurements. The discrepancy cannot be fully explained by uncertainties in the calculations, in the location of experimental points, or by uncertainties in the entropy and volume data used in the calculations. Instead, large systematic errors appear to exist in the values of free energy of formation for kaolinite and (or) the polymorphs of Al_2SiO_5. — *from* Author's abstract

01603 **Zenger, Donald H.** Supratidal dolostones — An overemphasis on their significance in geologic record? [abs.]: Am. Assoc. Petroleum Geologists Bull., v. 54, no. 3, p. 561, 1970.

08887 **Zietz, Isidore; Higgins, Michael W. The search for ore deposits using widely spaced aeromagnetic profiles [abs.]: Geophysics, v. 34, no. 6, p. 1020, 1969.**

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